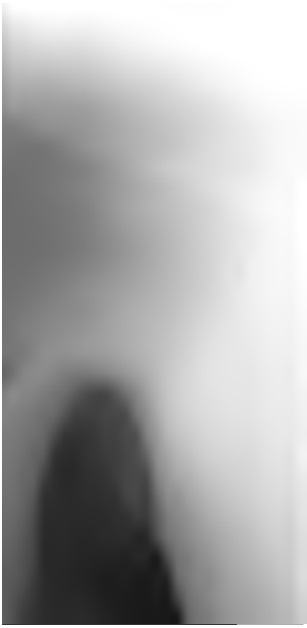

Hand Book
Gas Water Heaters

Ruud Instantaneous Automatic Water Heaters
Ruud Instantaneous Automatic Cottage Water Heaters
Ruud Multi-Coil Automatic Storage Systems
Ruud No. 30 Class Combination Storage System
Ruud No. 50 Class Combination Storage Systems
Ruud Tank Water Heaters

Tables of Standards and other
Useful Information

For the use of
Architects, Engineers, Gas Men, Plumbers and
all others engaged in construction and building

Compiled by
Ruud Manufacturing Company
Pittsburgh, Pa., U. S. A.

1915

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Introduction

The making of this, the third Ruud Hand Book of Information on Water Heaters, was approached with a willing spirit inspired by the very cordial reception given and kind words spoken for our earlier books.

We have tried in this book to make the information given as complete as possible and to include such data as will be found useful by those interested enough in the subject to read our efforts. Much data is included which will, at first glance, be questioned as to its worth in connection with water heaters. Our inclusion of this is due to the fact that the general and wide spread use of gas water heaters has led them into fields of industry where their application and successful installation is dependent upon engineering skill and practice.

The omission from this volume of any matters extraneous to the subject of specification, installation and care and maintenance may bring regret to some of our friends. In extenuation we would plead that the incorporation of such subjects as sales talks, testimonial letters and demonstration plans would have extended the size of the book to a point of inconvenience, thereby defeating the very purpose of its existence. On the other hand, a thorough mastery of the subjects included will inevitably result in the ability of the reader to write his own sales-talks and kindred topics.

In yielding place to that part of the book in which real helpfulness is to be found, if it is to be found in the book at all, we would again thank our friends for the reception given our former books, and, in advance, for their helpful criticisms of this book.

Ruud Instantaneous Automatic Water Heater

Protected by United States, British, Canadian, French, German and Russian Patents

U. S. PATENTS

Sept. 6, 1898	Dec. 31, 1907	Aug. 30, 1910
Sept. 10, 1901	Feb. 25, 1908	Nov. 15, 1910
May 31, 1904	Nov. 3, 1908	Feb. 23, 1914

Other patents pending

Ruud Instantaneous Automatic Water Heater

Thermal Valve Model
Type F

This type of heater has now come into very general use and is the most efficient and economical of all types of heaters where favorable conditions for its operation exist.

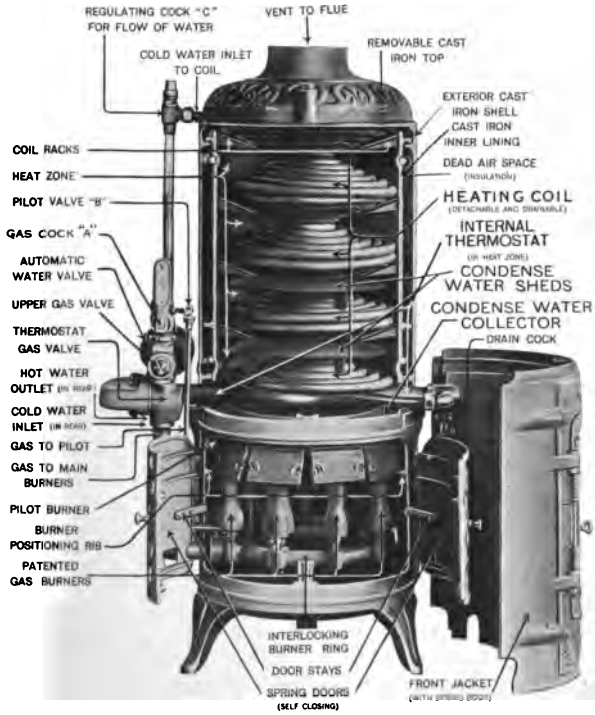
It combines instantaneous service with an inexhaustible supply of hot water and, since it uses fuel only when the want for hot water arises and is expressed by the opening of a hot water faucet, its economy is apparent.

The home is naturally the largest field for this type of heater, but it has an equal value in all other situations where hot water is required, as will be noted from the many and various uses to which the heater has been successfully applied.

The heater is very simple to install, involving no special fittings or devices, works successfully with any type of plumbing system, and is installed in connection therewith in the same manner as any other plumbing or gas fixture.

At the time of compiling this book there are approximately one hundred thousand of the Thermal Valve type heaters in successful use in the United States and Canada, which emphasizes the very wide distribution and general use into which the heater has now come.

This heater consists, as will be noted from the illustration on the opposite page, of a cast iron shell, enclosing the burners, heating surfaces and thermostat, and serving as a foundation and supporting structure of the heater. Within the upper half of the shell is an inner lining of cast iron forming a dead air space insulation. The burners are carried on a ring or manifold in the base of the shell. The coil, of copper tubing, through which the water flows as



General features of construction of the Ruud

Ruud Instantaneous Automatic Water Heater

Thermal Valve Model—Type F

(Continued)

it is heated, is supported by racks in the upper portion of the shell. Just below, but yet a part of the coil, is placed the thermostat in a horizontal position above the burners.

On the outside of the shell is placed the mechanism or automatic control of the heater. This consists of two gas valves of the simplest design, the first controlled by the water valve or motor cylinder, which is placed opposite it, and the second gas valve controlled by the thermostat, which, as before stated, is internally located in the heat zone of the heater.

The main or heating burners are fed by a gas line controlled by the two gas valves mentioned above. The pilot burner is fed by a separate line and is not affected by the operation of the automatic mechanism.

The opening of any hot water faucet unbalances the water pressures in the water valve, causing its plunger to move and open the gas valve controlled by it. The gas passes at once to the second gas valve which is controlled by the thermostat. If this valve is open, the gas goes to the burners where it ignites from the pilot flame. The water is then heated as it flows through the coil. Should the water become too hot, the gas would be shut off by the thermostat, until the water has become slightly less hot. The gas would then relight, providing the hot water faucet was still open. The closing of the faucet restores the balance of the water pressures in the water valve which immediately shuts off the gas from the main burners.

This operation is repeated whenever a faucet is opened. It will be noted that the gas, except the little pilot flame, burns only when water is being drawn.

Three-quarter View of Heater, showing **Automatic Mechanism**

Notes on Water and Gas Conditions

The successful operation of the Thermal Valve Model, Type F, Heater is dependent upon an ample supply of water and gas.

Artificial gas, natural gas and gasoline gas can be used, the only change necessary in the heater being the size of the orifices in the spuds on which the burners are mounted.

In the following pages will be found tables giving the proper sizes of water and gas pipes, size of meters, and other necessary data that has to do with the installation of the heater, and if these tables are adhered to the heater will invariably give perfect service.

This type of heater is made in two variations, commonly referred to as "Standard Pressure Heaters" and "Low Pressure Heaters."

The Standard Pressure Heaters are designed to operate under all conditions of water supply where the pressure in pounds per square inch is at least twenty-five pounds and over at the highest hot water outlet to be supplied.

The Low Pressure Heaters are designed to operate under all conditions of water supply where the pressure in pounds per square inch is below twenty-five pounds, and down to a minimum of four to five pounds at the highest hot water faucet to be supplied.

The water pressure conditions are usually of common knowledge to those interested in the installation, or easily determined, and should invariably be looked into prior to the installation of the heater.

It is of equal importance to have a heater properly adapted to the water pressure conditions as it is to have a heater of proper heating capacity for the work it is designed to do.

Conditions for the Best Service

As indicated on page 7, the successful use of this type of heater, or, for that matter, of any device ever invented, depends largely on its being installed under favorable conditions. However, it must not be taken from the following, that unless conditions are exactly as described the heater cannot give satisfaction. Rather, these conditions should be carried in mind as an ideal to come as near to as possible.

In most old buildings the heater must be connected to existing piping, which cannot conveniently be changed. In new buildings, on the other hand, the reader may determine from this book what are the best conditions for the heater's operation and, by incorporating in the new building these conditions, assure for himself, his client or customer, the best service of which the heater is capable.

The three essential factors which make for the successful operation of a heater are: The gas supply, the water piping and the flue.

The gas supply while important may be disposed of very quickly. On page 31 will be found a table of the proper sizes of gas piping to be run and meters to be supplied to each size of Instantaneous Automatic Water Heater. If these are strictly adhered to there can be no trouble from the gas supply.

Water conditions are extremely important, but thoughtful consideration will eliminate them as a source of trouble. On pages 31 and 32 are directions concerning the proper ordering of heaters for various water pressures, so the question of pressure may be assumed to be understood. Almost as important, however, as pressure conditions, is the subject of the size and length of pipes carrying the hot water from the water heater to the various faucets. The table on pages 213 and 214 shows the contents per unit of length for the most commonly used sizes of pipes.

When it is considered that the cold water lying in the pipe between the heater and faucet must be discharged before hot water can be drawn at the faucet, it will be at once apparent that the size and length of pipes carrying water to the faucet have a great bearing on the speed of delivering hot water to the faucet. It may be put down as a rule, therefore, that the pipe used in the delivery system of hot water should be as small in diameter as it is possible to use under the conditions (See table, page 214), and the layout of the piping should be such as to have the shortest runs possible to the various faucets. Suitable piping plans will eliminate not only excessively long waits for hot water, but also reduce radiation losses to the minimum both in direct and return circulation systems of plumbing.

Flue conditions are briefly stated, but are, nevertheless, of great importance. The heater should be connected to a flue having a good draft. An independent flue is desirable. The heater should be located near enough to the flue to avoid the necessity of a long level run of smoke pipe as a connection.

Given then, the proper size heater, a proper understanding of the few conditions, emphasized above, will in every case, if followed out, insure good service from the heater selected.

Sizes of Heaters
Their Application to Residences

Thermal Valve Model, Type F, Heaters are made in four sizes—numbered Three, Four, Six and Eight—the size number of the heater indicating the number of gallons of water heated per minute—raised 63° F. using artificial gas, or 80° F. using natural gas (See capacities of heaters page 195.)

While we would not eliminate a careful consideration of the tables given elsewhere as a guide to the application of heaters for any particular installation, we would present as a quick reference table the following as applied to heaters for residential use:

Size Heater	Gals. per Min.	Residences having
No. 3	**3**	One bathroom and kitchen sink, Small family.
No. 4	**4**	One family bathroom, one servants' bathroom, kitchen and laundry.
No. 6	**6**	Two family bathrooms, one servants' bathroom, kitchen, pantry, laundry and one or two lavatories.
No. 8	**8**	Three or four family bathrooms, servants' bathroom, kitchen, pantry, laundry and lavatories.

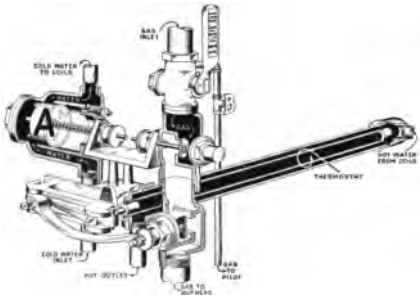
In applying this table to apartment buildings, which is, in a sense, residential use, a very good rule is to consider each apartment as needing three gallons per minute. The chance of all apartments drawing water at the same time being small, however, it is safe to specify a heater having a capacity of two-thirds as large as the above rule calls for. Thus: An apartment house with four apartments would call for twelve gallons per minute, but only two-thirds of this, or eight gallons, need be provided, which could be done by a Number Eight heater.

This rule would, of course, apply only to apartments having not more than the number of fixtures as given for residences which could use a Number Three heater in the above table, and to buildings where such apartments are located above one another so that the pipe distances are short.

The Anatomy of the Ruud

Mechanism of the Ruud Automatic Gas Water Heater

The illustration shows the general arrangement of the internal thermostat, temperature controlled gas valve water valve, and water pressure controlled gas valve.



Opening a hot water faucet reduces the water pressure upon the front of the water valve plunger "A" to the head derived from the height of the faucet above the plunger, while upon the rear of the plunger is exerted the full pressure from the main. In other words, the pressures on the front and back of the plunger are unbalanced. The greater pressure on the rear causes the plunger to move forward, opening the opposite or primary gas valve. The gas is then free to pass into the lower or secondary gas valve which is controlled independently by the temperature of the water.

As long as the hot water faucet is open, the primary or water pressure controlled gas valve will remain full open.

Assuming that the water in the coils is cold, the heater not having been used for some time, the lower gas valve will be open, allowing a free passage of gas to the main

burners where it is ignited and thereafter instantly heats the water in the copper heating coils as rapidly as it passes through the heater.

If the amount of water being drawn is less than the rated capacity of the heater there would be a tendency to overheat the lesser amount of water, with a consequent dangerous temperature and a considerable waste of fuel. This condition is avoided by the action of the Internal Thermostat responding to the increasing temperature, causing the secondary or temperature controlled gas valve to slightly close down the flow of gas, and if the water comes up to the adjustment to which this valve is set it will close off the flow of gas entirely.

If the water valve should become inoperative and the plunger stick when it is in a forward position, preventing the upper gas valve from closing, the Internal Thermostat feeling instantly the increasing temperature of the water, takes up the control of the flow of gas, and the heater will continue in perfect operation without any injury or danger.

The water valve, owing to the fact that the water from the mains sometimes carries stones, sticks, sand and many other impurities, is liable to stick in a forward position. Should this occur, the Internal Thermostat will assume entire control of the gas flow and act positively as a factor of safety against any damage to the heater by excess of temperature.

As a further element of safety, the thermostat is so arranged that the breaking of any part of it would instantly close the gas valve and it would be impossible for the burners to be lighted until the thermostat was repaired and adjusted.

To protect the levers from accident and render them fool-proof from meddlers, an iron cap encloses them. This cap is quickly removable, if desired.

Directions for Setting and Operating the Ruud Instantaneous Automatic Gas Water Heater

Model F

To Fit up Heater

First—Cold water connection must be made to the inlet marked "Cold," placing union and valve in the water line close to water valve on heater; the union being placed between valve and heater. Lead on male threads only.

Second—Hot water connection from heater must be made to outlet tagged "Hot," placing union and check valve in pipe; the union being placed between check valve and heater. Lead on male threads only.

Third—Gas connection to heater must be as specified in table below. Run gas line direct from meter. Put gas cock in the line. Meter must not be smaller than specified in table below.

Fourth—Always test chimney hole for draft, and see that flue is free and clear of obstructions. Then make connection from heater to chimney, placing Ruud Draft Hood vertically in the pipe. Do not use pipe smaller than called for in table below. **Important.**

Fifth—Open every hot water faucet in the house to let all air out of pipes.

Fitter's Specifications for all Sizes of Thermal Valve Model, Type F Heaters

Size Heater	Water Inlet	Water Outlet	Gas Line From Meter	Size Vent Pipe	Size of Meter	Adjust flow of Water at Valve "C" to
No. 3	½"	½"	1"	6"	30 Lgt.	3 gal. per min.
No. 4	½"	½"	1¼"	6"	45 Lgt.	4 gal. per min.
No. 6	1"	¾"	1½"	7"	60 Lgt.	6 gal. per min.
No. 8	1"	1"	2"	8"	80 Lgt.	8 gal. per min.

To Start Heater

FIRST—Close Gas Cock "A" and Pilot Valve "B."

SECOND—Wait five minutes.

THIRD—Open Valve "B," light and adjust pilot burner to a very small flame.

FOURTH—Turn Gas Cock "A" full open.

FIFTH—Adjust gas flow at cock on gas line to proper rate of flow.

Carefully Note

A self-closing faucet placed on the kitchen sink prevents waste of hot water, and therefore saves gas.

Examine burners carefully to see that all are properly placed on spuds before lighting heater.

Heaters for artificial gas, natural gas or gasoline gas are alike in every detail, except size of orifice emitting the gas to the burners.

Be sure that the heater is leveled and has a substantial foundation.

Always set the heater nearest to the point where the hot water is used most frequently.

Do not run piping where it will interfere with removing valve caps, thermostatic lever hood, etc.

Operation

The opening of any hot water faucet will cause the gas in heater to automatically ignite at the main burners, and a continuous flow of hot water will follow.

Upon closing the faucet, the gas will automatically be shut off from the main burners, and only the small pilot light will be left burning.

Regulation

The heater is usually adjusted at the factory to produce water at a temperature of about 140°. In order to test the adjustment, first regulate the flow of water through the heater to its rated capacity at Valve "C," then draw hot water at nearest point to heater at the rate of about one-half the per minute capacity of the heater. The temperature should now show 140 to 150 degrees, the gas at this time shutting off and on intermittently. If not up to this point, turn regulating screw "J" a trifle in, and if the temperature is too high turn the screw "J" a trifle out to lower the adjustment. A one-quarter turn usually makes a change of about ten degrees in the temperature of the water.

NOTE—You will invariably find that, by regulating the flow of water to the rated capacity of the heater, the temperature will be satisfactory for all purposes, and it is advisable to not disturb the thermostatic adjustment under any circumstances.

NOTE—If after the directions have been fully complied with it is found that hot water is not obtainable, it is usually due to one or more of these causes: insufficient gas, too much water passing through the heater, or defective draft.

For Further Information see "Care and Maintenance of Water Heaters"

Water and Gas Connections

Cold Water

The connection from the cold water main to the inlet of the heater should be taken off the house-main, if possible, but if not, it should be taken off a branch pipe of larger size than the heater inlet. The object of this is to bring as much pressure and flow as possible directly to the heater. In the cold supply line should be placed a valve and a union, with the union between the heater and the valve. Care must be used that piping is not placed where it will interfere with the removal of heater parts.

Hot Water

The hot water line should be run from the outlet of the heater by as short a distance as possible to the hot water main of the house. The size of pipe used should be the size of the heater outlet. It is sometimes advisable, as an aid to economical operation, to run an independent line to a frequently-used faucet if the run to that faucet by way of the hot water main is unnecessarily long. In such cases the pipe used in the independent line should be as small in diameter as will provide a good flow at the faucet. Care must be used that piping is not so placed as to interfere with removal of heater parts.

In the hot water connection should be placed a balanced swing check valve and a union, the union being placed between the heater and the valve.

This check valve prevents water from flowing backward through the heater should a shortage of cold water occur.

Gas

The gas connections should always be run of the size specified in the table on page 31, and should be increased one size over that if the distance be extremely long. A separate gas line to the heater direct from the meter should be used and no branches taken from it or other appliances supplied by it. In this line a gas cock should be placed.

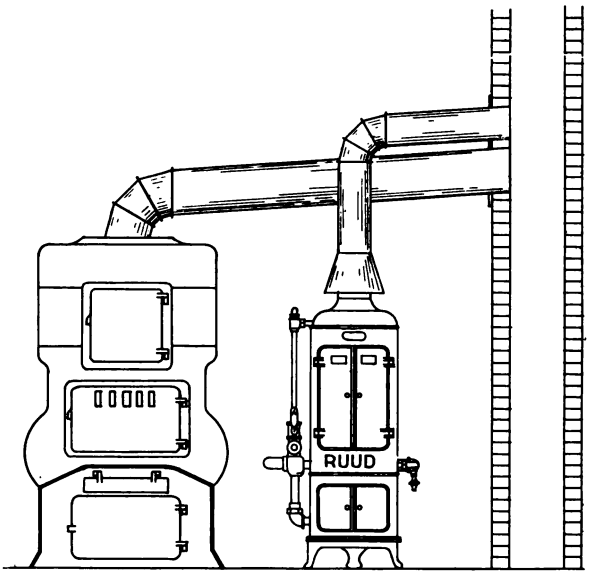
The meter used must be of the capacity called for in the table and the "Caution Tag" accompanying each heater must be attached to the meter cock. This tag will prevent any person of ordinary intelligence from turning off the gas at the meter without first turning off the valves, both Main Valve A and Pilot Valve B of the heater.

Location

The location of the heater is a point of the greatest importance and careful judgment must be exercised to set the heater at the point where it will render the best service.

The flue is first considered. A flue with a good draft having been located, the heater must be set near enough to it to avoid the necessity of using a long flat run of smoke pipe as a connection. No definite distance can be set down as a limit to the distance a heater may be set from a flue, as the strength of the draft in the flue is the governing factor and this is very variable. The high efficiency of the Ruud Water Heater leaves a very small percentage of heat in the escaping gases and hence little dependence may be placed on the ability of the heater to create a draft.

The next point to be considered in the location of the heater is to set it at a point where it can be connected



The Ruud installed, venting into chimney used by other appliance

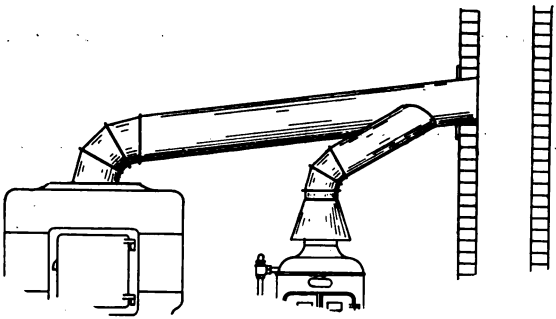
to the most frequently used faucet by the shortest possible run of pipe. In most residences the kitchen faucet is more frequently used than any other, and hence in most cases it is wise to favor the kitchen and locate the heater as near to it as possible.

Flue Connection

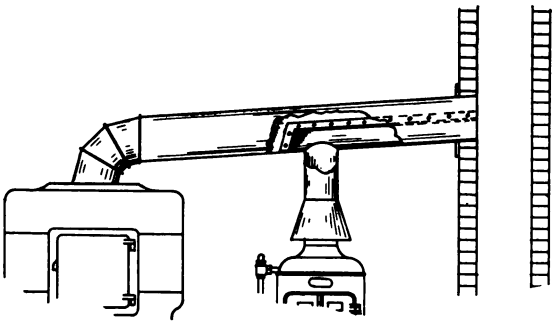
A good flue connection is essential to the successful use of a Ruud Water Heater. An independent flue is very desirable, but this is not always possible to obtain, especially in old buildings. Where an independent flue cannot be secured a flue venting another appliance may be used if it has a good draft. Great care must be exercised in connecting a Ruud Heater to a flue used by some other appliance, that the draft of the other appliance be not affected injuriously, especially if the other apparatus is a coal or wood burning appliance.

In connecting a heater to a flue already used by another appliance a separate hole in the brick chimney breast should be made to admit the connection from the Ruud. Where this is not possible, the flue connection from the Ruud may be joined to the flue connection of the other appliance at such an angle that the gases from the Ruud will enter the flue connection of the other appliances flowing in the same direction, or nearly so, as the products of combustion of the other appliance.

Finally, when neither a separate hole in the breast or a favorable angle for joining the two flue connections may be secured, the connections may be joined and a diaphragm or sheet of metal be placed in the larger flue at the point where the connections join, in such a way that the directions of the flowing gases are made parallel before they are permitted to mingle. It is well to enlarge



The Ruud installed, venting into the flue from another appliance; favorable angle of connection



The Ruud installed, venting into the flue of another appliance; unfavorable angle properly diaphragmed

the flue connection from a point just before that where the Ruud connection joins and continue the enlarged pipe into the breast.

It is important that the flue connections of the sizes called for in the table on page 31 be used. No reduction should be permitted.

The Ruud draft hood should be placed at the highest point in the line where it can be set vertically. This will prevent any down draft from entering the heater and also prevent an excessive up draft from withdrawing the gases from the heater before they have given up their full measure of heat.

Condensation

The condense water which is formed on the upper coils of the heater whenever the heater goes into operation, and which trickles down the outside of the tubing, is a natural result of the combustion of the gas. This condensation, commonly called "Sweat", is due to the fact that all combustible gases in common use, whether manufactured, natural or gasoline gases, contain a large proportion of hydrogen. The hydrogen of the gas, when burned, forms water in the form of vapor and this water vapor coming in contact with the cooler coils at the top of the heater condenses upon them, forming drops which eventually form so fast that the dropping water is frequently mistaken for a sign of a leak in the coil.

The average manufactured gas produces over six gallons of water in the burning of a thousand cubic feet of gas. A great part of this water collects upon the coils of an instantaneous automatic water heater.

Most gases, while they do not contain much, if any, free sulphur, do contain some sulphur in one form or another. These sulphur compounds, when burned, form a vapor which, mingled with the water vapor mentioned above

The sheds in the coil deflect the acid water to liners of heater, protecting coils and burners

The condense water is drained to outside rear of heater, provision being made to connect to drain

form, at once, sulphuric acid. The condense water, then, is really a dilute solution of Oil of Vitriol or Sulphuric Acid.

The destructive effect of this acid being so well known, it is scarcely necessary to point out the possibility of damage from it were it allowed free contact with the coils, burners, burner ring and burner chamber. The knowledge of this possibility, together with actual results of the acid on earlier models of heaters, impelled the researches which developed the system of collection and disposal of this destructive element which is now incorporated in all Type F, Thermal Valve Model, Ruud Heaters.

This method of eliminating the effects of condensation consists of a series of light cast-iron water sheds inserted between the spool-like sections of the coil and an iron gutter which is concentric with the burner chamber.

Note that it is the "Effect of Condensation" only which is eliminated. No claims are made that the condensation itself is eliminated. The falsity of such a claim would be instantly apparent when it is realized that the amount of condensation formed is in exact proportion to the service the heater is giving.

The deflectors, or water sheds, are placed between the spools of the coil, as shown in illustration, and throw the condense water coming from the coil to the side of the heater. Thence the water flows to the collector suspended below the coil, and is drained to the outside of the heater.

This very valuable improvement is a patented feature, to be obtained only in RUUD Heaters.

Re-Heating or Supplementary System

The model installations on pages 35 and 36, show one of the most popular methods of installing the Ruud Instantaneous Automatic Gas Water Heater in those houses where additional sources of heat are utilized for heating water. The economy and general desirability of this system will be appreciated on reading the following brief description of it.

In this system the boiler, which may be heated by a water back in the range, heating coil in the furnace, steam coil or any other available source of heat, is utilized as a feed for the Ruud Heater. In the hot water main leading from the boiler to the faucets is placed a valve at a point between the boiler and the faucet nearest to it. From the main, on the boiler side of the valve, a line is run direct to the inlet of the Ruud, and from the outlet of the Ruud a line is run to the nearest available point on the main, on the faucet side of the valve.

It will be plain from the above that the Ruud is in a loop or shunt of the hot water main and that if the valve placed on the main, known as the "By-Pass Valve," be closed, any water flowing from the boiler to a faucet must pass through the Ruud.

When a hot faucet is opened the heater immediately lights in the regular way, but if the water in the boiler be hot, above the temperature adjustment of the Ruud, usually 140 degrees, the thermostat will extinguish the gas in a few seconds upon the arrival of this hot water from the boiler at the thermostat. The gas will then remain closed off as long as the hot water is flowing. However, should the temperature of the flowing water decrease, the Ruud would instantly light up and, by reason of the sensitiveness of its thermostat, burn just enough gas to

bring the temperature of the flowing water up to the point desired. The Ruud would be regarded in this system as an inspector of all the hot water. If the water, as it passes through the Ruud, be hot, the Ruud wastes no gas upon it; if the water be only partially heated in the boiler, the Ruud adds the necessary heat to the water and burns gas only in proportion to the amount of heat needed; or if the water coming from the boiler be cold, the Ruud will do the entire work of heating all the water.

Thus it will be seen that the supply of hot water will be never failing. It may be coming from the boiler, or the Ruud, or both, but it will be certain that the opening of the faucet will bring hot water.

The Ruud, regarded as an auxiliary, will insure an absolutely reliable hot water supply and charge in gas only for the hot water demanded, which the primary or main source of hot water could not supply. Or, if the Ruud be regarded as the primary source of hot water, it will credit, in gas not used, any hot water derived from the boiler.

As in the ordinary direct system of installation, the Ruud can burn gas only when a hot water faucet is open, and not then unless the water needs the heat. The economical advantage of this system will be seen at once.

At the risk of repetition we would point out again that in this system the Ruud does not heat the water in the boiler. It merely intercepts it on the way from the boiler to the faucet, and adds whatever heat may be necessary.

General Table Standard Pressure Heaters

(Natural and Artificial Gas)

Size	Per Min. Capacity	Average Temp. Rise Nat. Gas	Average Temp. Rise Art. Gas	Length of Coil	Outside Dia. of Tubing	Dia. Water Valve	Size Water Inlet	Size Water Outlet	Water Pressure Minimum
No. 3	3 Gal.	80°	63°	68′	¾″	2″ or 3″	½″	½″	20 lb.
No. 4	4 Gal.	80°	63°	100′	¾″	2″ or 3″	½″	½″	20 lb.
No. 6	6 Gal.	80°	63°	125′	⅞″	2″ or 3″	1″	¾″	20 lb.
No. 8	8 Gal.	80°	63°	168′	⅞″	2″ or 3″	1″	1″	20 lb.

Size	Size Gas Meter	Gas Consumed Per Min.	No. Burners	Orifice Nat. Gas	Orifice Art. Gas	Orifice Gasoline Gas	Size Gas Line	Size of Vent	Weight Crated	Weight Net
No. 3	30 Lgt.	3 cu. ft.	12	52	40	36	1″	6″	320	270
No. 4	45 Lgt.	4 cu. ft.	15	52	40	36	1¼″	6″	380	320
No. 6	60 Lgt.	6 cu. ft.	23	52	40	36	1¼″	7″	540	425
No. 8	80 Lgt.	8 cu. ft.	30	52	40	36	2″	8″	670	550

NOTE—Table of Low Pressure Heaters, Page 32

General Table Low Pressure Heaters

(Natural and Artificial Gas)

Size	Per Minute Capacity	Average Temp. Rise Nat. Gas	Average Temp. Rise Art. Gas	Length of Coil	Outside Dia. of Coil	Size Water Inlet	Size Water Outlet	Water Pressure Minimum
No. 4	4 Gal.	80°	63°	86′	7⅝″	¾″	¾″	4 to 5 lb
No. 6	6 Gal.	80°	63°	100′	1″	1″	1″	4 to 5 lb.
No. 8	8 Gal.	80°	63°	150′	1″	1″	1″	4 to 5 lb.

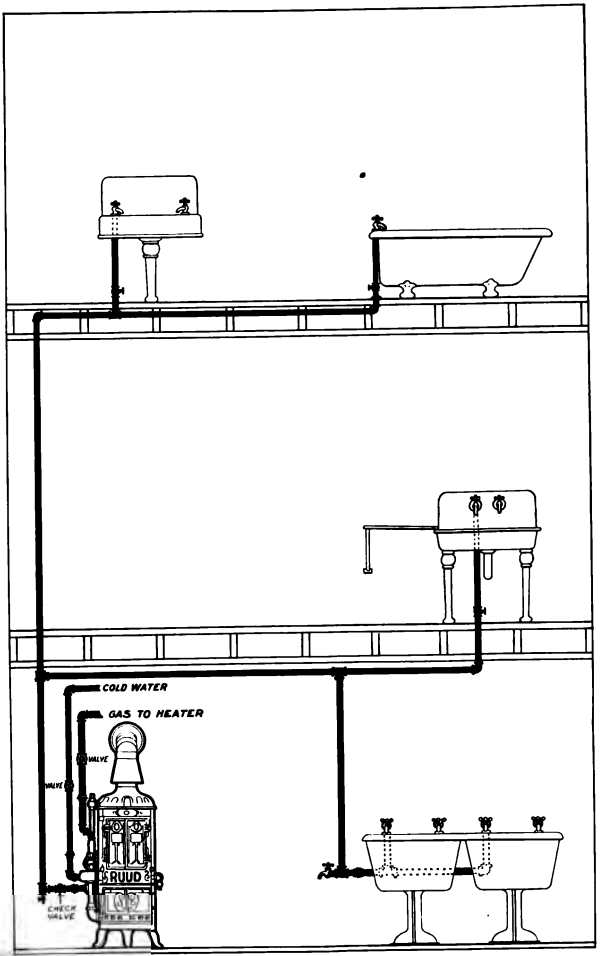
Size	Size Gas Meter	Gas Consumed Per Min.	Number Burners	Orifice Nat. Gas	Orifice Art. Gas	Orifice Gasoline Gas	Size Gas Line	Size of Vent	Weight Crated	Weight Net
No. 4	45 Lt.	4 cu.ft.	15	52	40	36	1¼″	6″	380	320
No. 6	60 Lt.	6 cu.ft.	23	52	40	36	1½″	7″	540	425
No. 8	80 Lt.	8 cu.ft.	30	52	40	36	2″	8″	670	550

NOTE—Table of Standard Pressure Heaters, Page 31

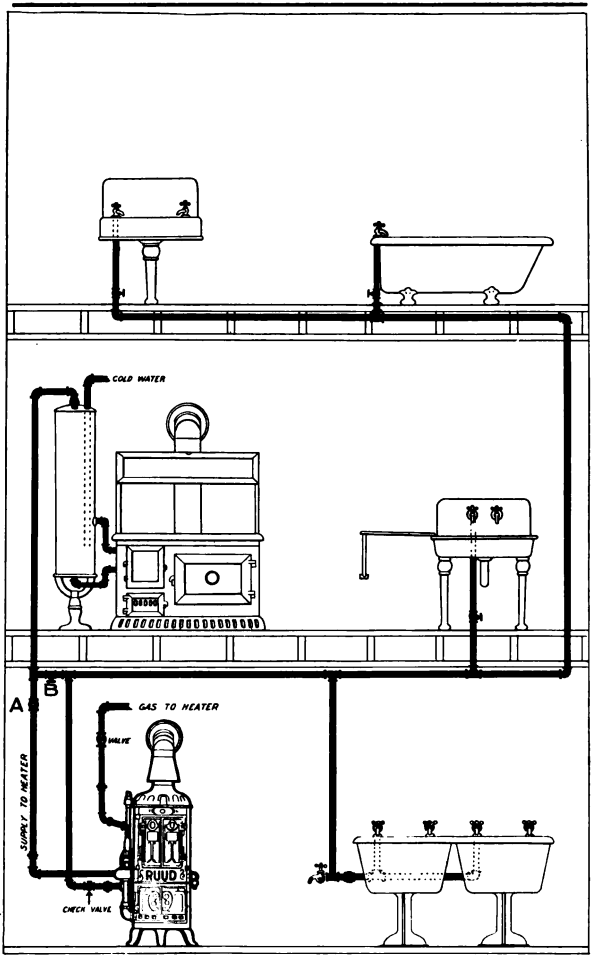
Model Installations

The majority of new homes having modern plumbing systems with direct city pressure, the installation of Instantaneous Automatic Water Heaters is generally a simple problem. There are, however, thousands of older houses in which the plumbing is more or less complicated. The attachment of a heater to this plumbing requires sometimes considerable skill, which is secured only by experience with heaters. We illustrate on the following pages some of the most commonly met plumbing systems, and the correct methods of installing in connection with them a Ruud Instantaneous Automatic Water Heater.

While we show many conditions in these illustrations, we realize that it would be a hopeless task to endeavor to show all that might be met with. New problems are confronted each day. We would therefore urge any of our friends meeting a problem not illustrated herein, or to whom these illustrations are not clear, to feel that by writing us and stating his problem he will be conferring a favor upon us. We will take the utmost pleasure in giving him the benefit of our experience.

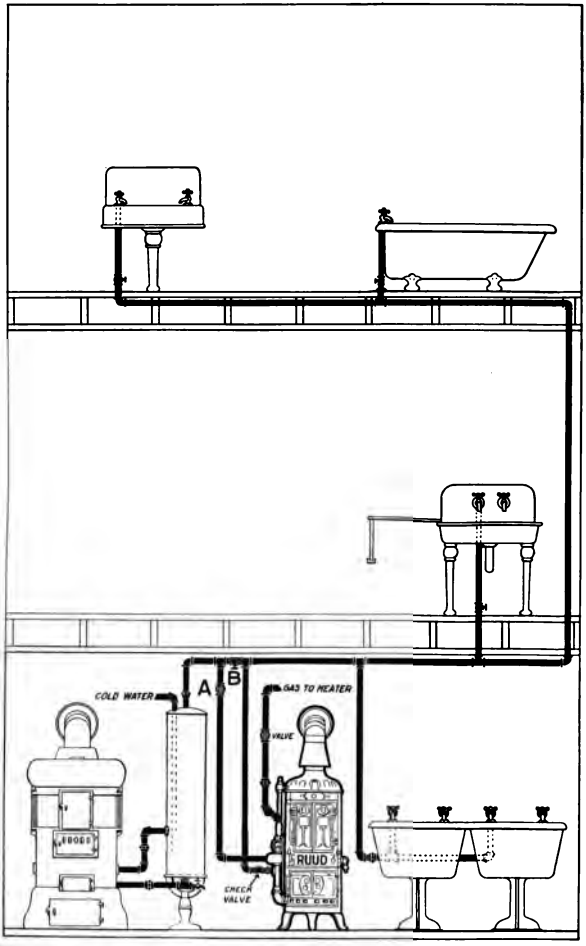


The Ruud installed on direct system of plumbing, supplying hot water all over the house

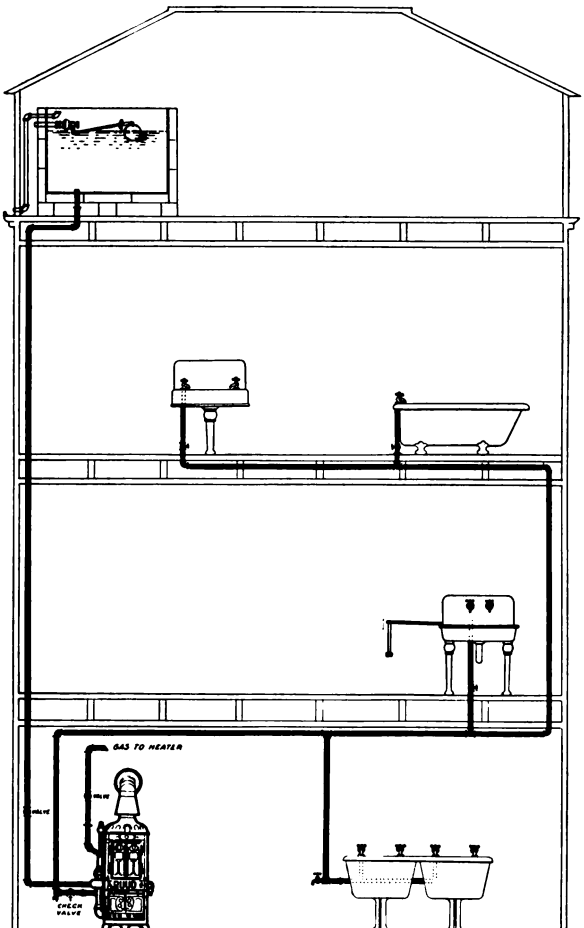


The Ruud installed on Re-heating system in connection with range boiler

NOTE—Re-heating or supplementary system fully explained on pages 29 and 30

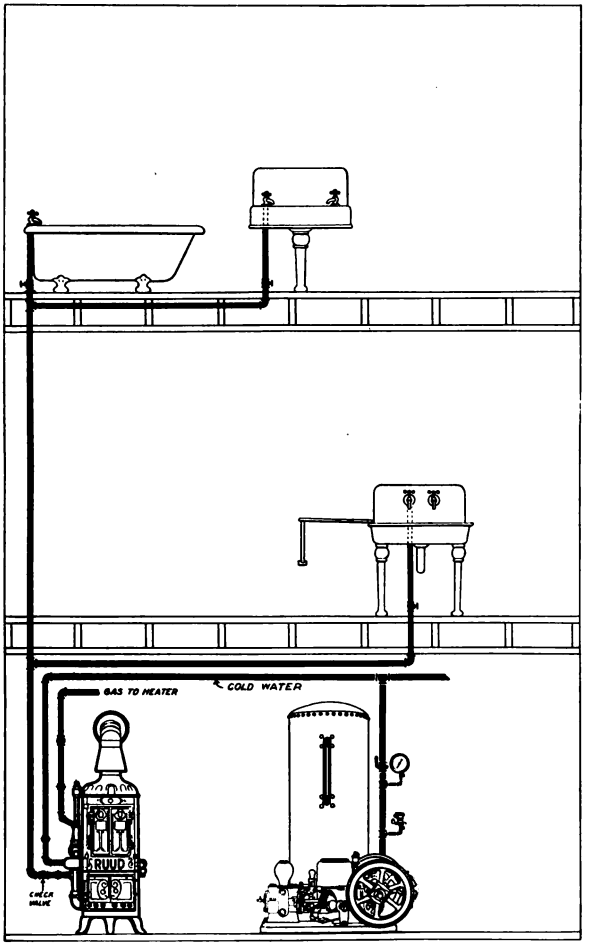


Ruud installed on Re-heating system, the boiler being heated in the winter time by coil installed in the house heating plant

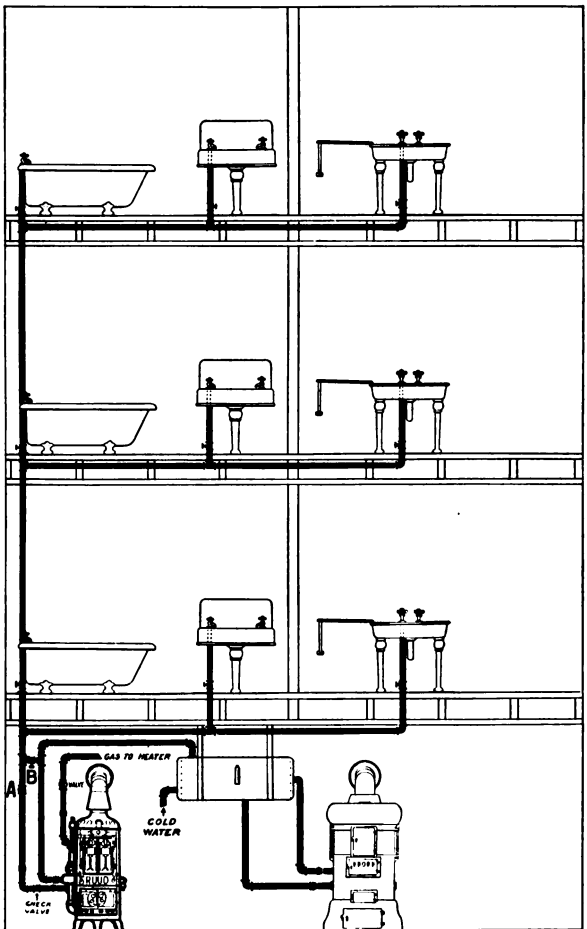


The Ruud installed on direct system of plumbing, water supplied under gravity system from attic tank

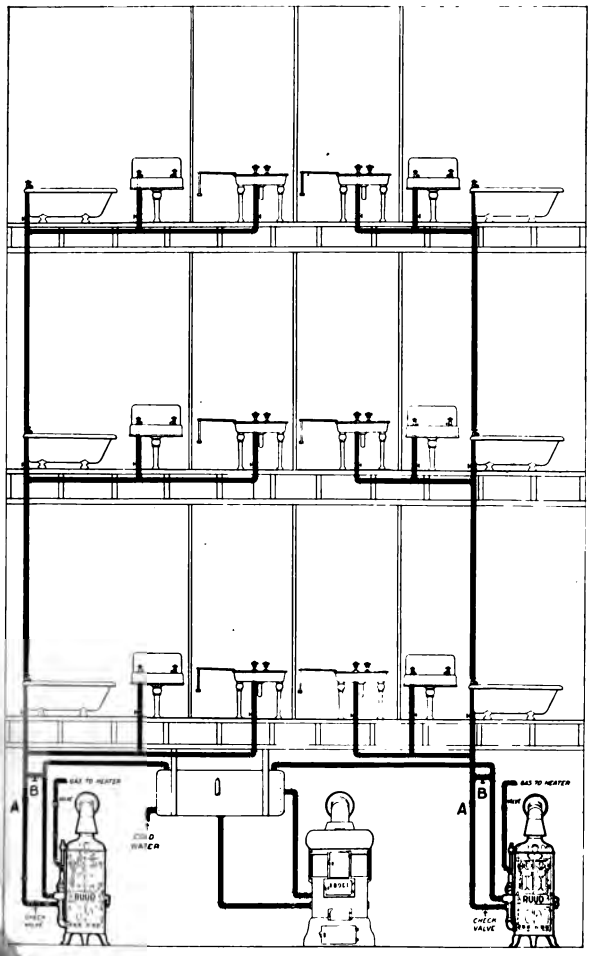
Note—Minimum distance between highest faucet and bottom of tank, 8 feet.



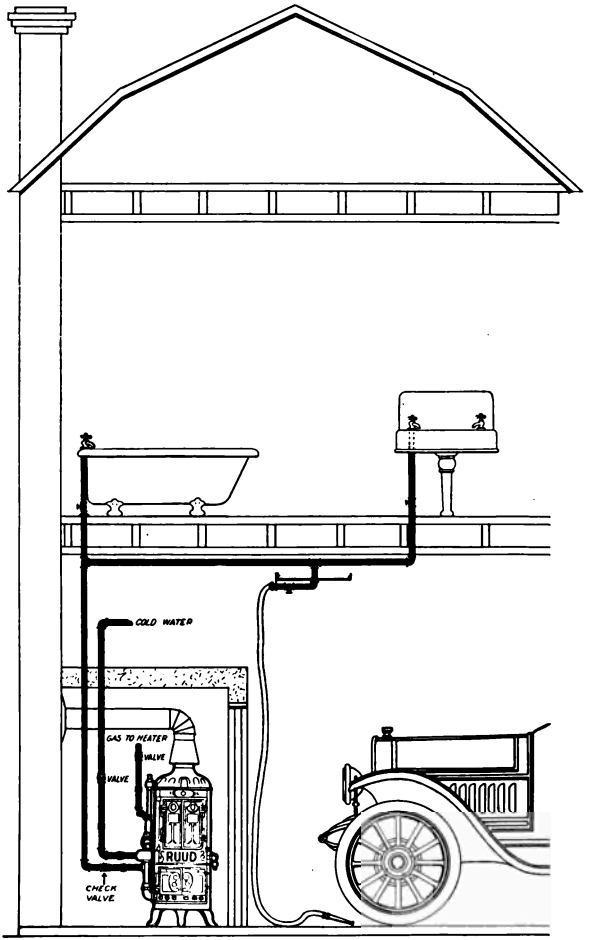
Ruud installed on direct system of plumbing, water supplied under pressure of pneumatic tank



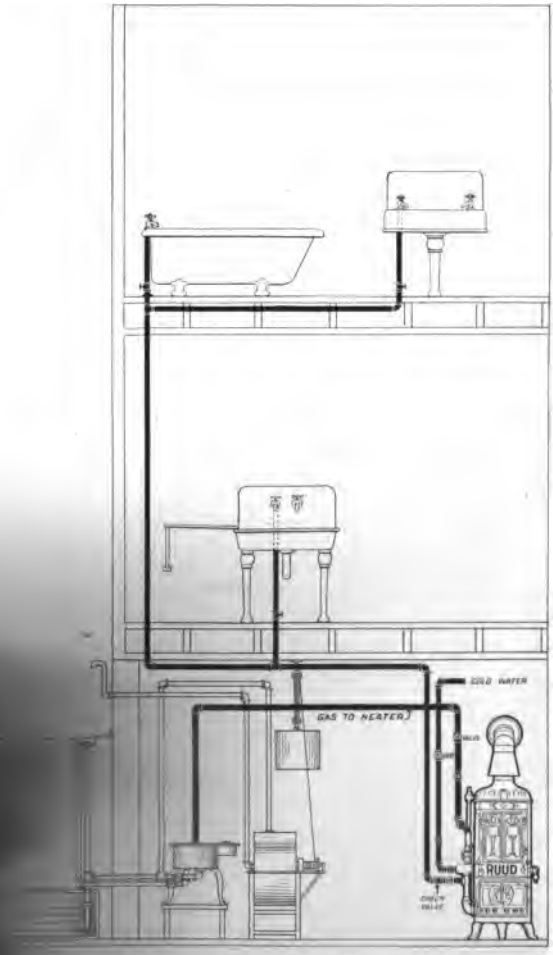
The Ruud installed on direct system of plumbing in three-apartment building, on Re-heating system, in connection with boiler heated by coil installed in the house heating plant



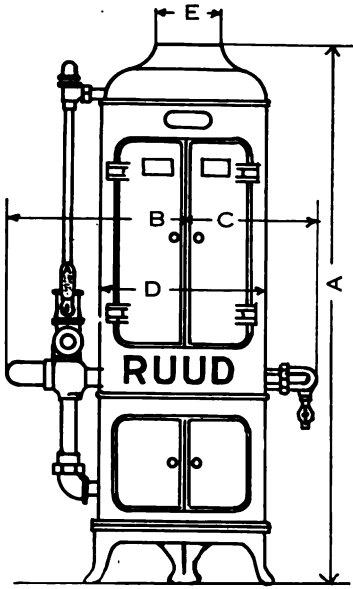
Ruud installed on Re-heating system in six-apartment building, working in connection with boiler heated by coil installed in the house heating plant



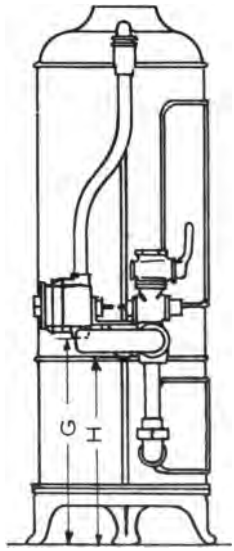
The Ruud installed in private or public garage



The Ruud installed on direct system of plumbing, gas supplied from Gasoline Gas Generator



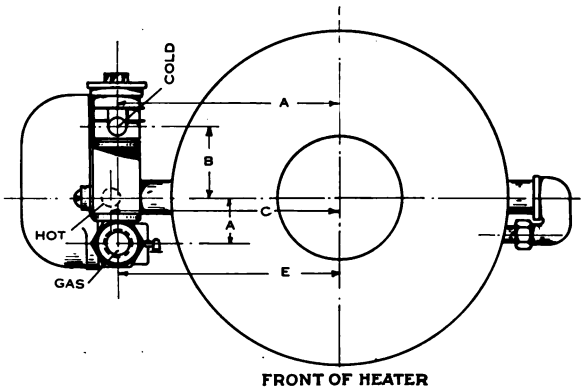
Front View



Side View

Table of Heater Dimensions

Size	A	B	C	D	E	G	H
No. 3	3′ 9½″	14¾″	11″	14½″	6″	20¼″	19″
No. 4	3′ 11¼″	15 7/16″	12″	16⅜″	6″	20¼″	19″
No. 6	4′ 7½″	17¼″	13⅜″	19″	7″	22″	20⅞″
No. 8	4′ 10½″	18⅜″	14″	21¼″	8″	22″	20⅞″



Plan View

Table of Roughing-in Measurements

	A	B	C	D	E
	10″	3½″	10 5/16″	2¼″	10″
	10 11/16″	3½″	11″	2¼″	10 11/16″
	12⅜″	3½″	12⅝″	2⅜″	12⅜″
	13¾″	3½″	14″	2⅜″	12¾″

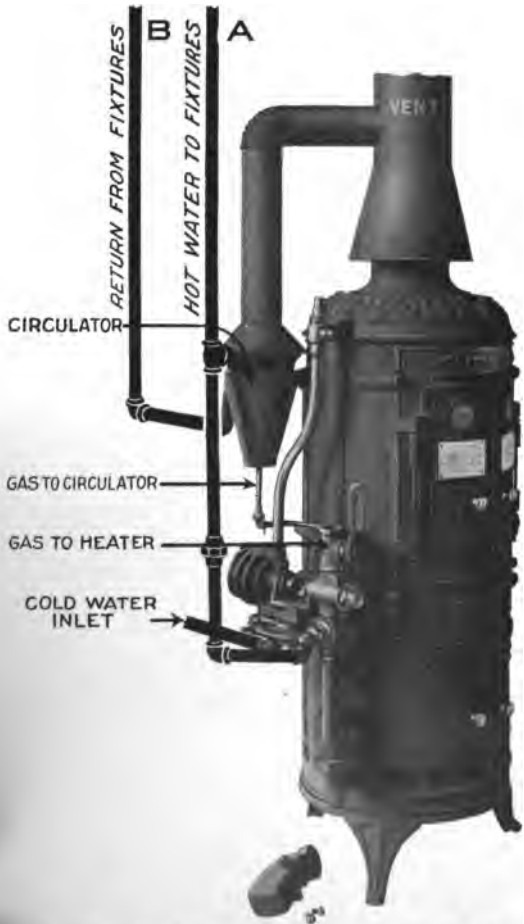
Ruud Instantaneous Automatic Water Heater

Installed with Return Circulation System of Plumbing

The cut on the following page illustrates the RUUD installed under Return Circulation System of plumbing. This feature, a comparatively new one, now enables instantaneous automatic water heaters to be installed in many jobs heretofore found impractical. Special attention is invited to the manner of handling the circulating water. The standard heater, either high or low pressure as may be required, is used in this work, and is supplied with a circulating attachment built on as illustrated, or the attachment can be added to heaters now in use.

In operation, the circulating pot being heated by a small economical pilot burner is sufficient to add the necessary heat to the water to drive it up the leg "A" returning by the leg "B." When the hot water faucet is opened, the travel of the water is the same as in the case where heater is used on direct supply, passing through the coil of the heater, being heated instantly, and travels up the leg "A" to the fixtures. Upon closing the faucet the gas is shut off, and the water in all the lines becomes equalized. The circulation in the loop is now restored and continued by the pilot burner under the circulator.

The fitters data, dimensions, and all other statements of capacity and size are applicable to the heater used in this work. Heaters are supplied complete as illustrated, with circulator pot attached, or the circulator can be supplied for heaters now in use.



The Ruud with circulator attached, installed with return circulation system of plumbing

Ruud Instantaneous Automatic Water Heater

With Soda Container Attached

Beer Pipe Cleaner

Beer pipes take on a coating which, if not removed periodically, seriously affects the quality of the beer.

Many cleaning compounds are offered as a means of removing this fungus growth from the pipes. The base of most of these compounds, however, is common washing soda, and it is not very effective unless used with hot water.

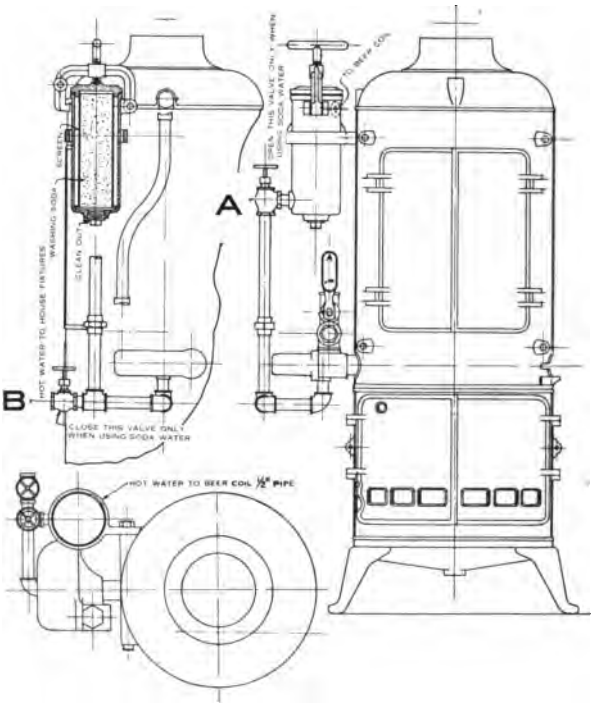
The RUUD is now offered with a Soda Container designed to attach to heaters now in use, or the heater is supplied complete as illustrated.

By a unique arrangement of the valves as supplied with the heater, it serves the purpose for pipe cleaning by passing water through the Soda Container and thence to the beer pipe, giving off a heated saturated soda solution, which effectively cleans the beer pipes. The operation is a simple one, enabling the user to clean the pipes at frequent intervals with minimum trouble.

When the pipe cleaning operation is over, resetting a few valves throws the heater back on the domestic supply for lavatory and cleaning use, the water then by-passing the soda container.

All those interested in this problem will recognize this arrangement as a unique and effective solution of the trouble.

The Soda Container is supplied for all size Model F Heaters, Nos. 3, 4, 6 and 8.



The Ruud, with Soda Container attached

To obtain saturated soda solution, close valve "B" and open valve " A." To obtain ordinary heated water, close valve "A" and open valve " B."

Structural Specifications

Ruud Instantaneous Automatic Water Heater Thermal Valve Model, Type F

SHELL Best grade light grey iron castings. Sectional construction assembly for ease of dismounting. Shell consists of rear shell or back section, carrying double spring doors on upper half; upper and lower front sections both carrying double spring doors; inner lining of cast iron on upper half of shell and on upper doors, providing dead air space for insulation, reducing radiation loss to minimum; top casting and base. Base forms a pan for collection of condensation and is tapped for attachment of permanent drain connection. All parts of shell assembled by heavy bolts as few in number as possible.

COILS Seamless copper tubing, tested to stand hydrostatic pressure of 1000 pounds per square inch, tested again after assembling to 300 pounds per square inch. Coil formed of several helical staggered sections of convenient length joined by brazing, or couplings when ordered. In latter case all sections are detachable. Section of coil in fire zone of heavier gauge.

BURNERS Burners are of best grade grey iron castings with separable cap and perforated flat copper flame check. Cap, Flame Check and Mixer Casting held firmly as a unit with two brass bolts. Burners are mounted in battery on brass spuds in burner ring or manifold.

Brass bolts and spuds make for ease of dismounting no matter how long in service.

MECHANISM Patented Ruud Dual Fuel Control, consisting of water pressure valve or motor cylinder, operating independent gas valve of simplest construction, internal thermostat controlling independent gas valve. The two controls of gas flow, by water and thermostat, entirely independent of each other, yet making for a control of the gas instantly responsive to conditions and absolutely safe under all conditions.

CONDENSATION COLLECTORS Two concentric shields or baffles of light cast iron, mounted in coil sections to divert dripping condensation to outside of coil; iron gutter on inside of shell catches dripping from baffles and carries condensation to outside of heater and drain connection.

Where the Ruud Can Be Used

Residences
Cottages
Apartments
Hotels
Garages (Private)
Garages (Public)
Art Glass Works
Specialty Manufacturers
Bakeries
Confectioners
Lunch Stands
Barber Shops
Chiropodists
Manicurists
Billiard Parlors
Cigar Stands
Book Binders
Printers
Railway Offices
Bath Houses
Hospitals
Dentists
Restaurants
Cafes
Jewelry Mfrs.
Electric Mfrs.
Photographers
Breweries
Bottling Houses
Builders
Contractors
Food Mfrs.
Chemical Labs.
Mfg. Druggists
Churches
Amusement Parlors
Meeting Halls
Tobacco Mfrs.
Cleaners & Dyers
Clothing Mfrs.
Drug Stores
Electrotypers
Engravers
Banks
Express Offices
Gymnasiums
Leather Mfrs.
Surgeons
Physicians
Clubs
Saloons
Laundries
Newspaper Offices

Ruud Instantaneous Automatic Cottage Water Heater

This heater embodies the same general principle of construction and operates in the same manner as the Ruud Instantaneous Automatic Water Heater of larger size. It is equally efficient and economical, where favorable conditions for its installation exist.

As suggested by its name, this heater is designed especially for places and purposes where only a small amount of hot water is wanted per minute, and generally where only one fixture is to be supplied.

If more than one fixture is to be supplied they should be located very near each other, so the heater can be installed close by.

This heater now makes it possible to provide instantaneous, automatic hot water service in small homes and for other special purposes at a low first cost.

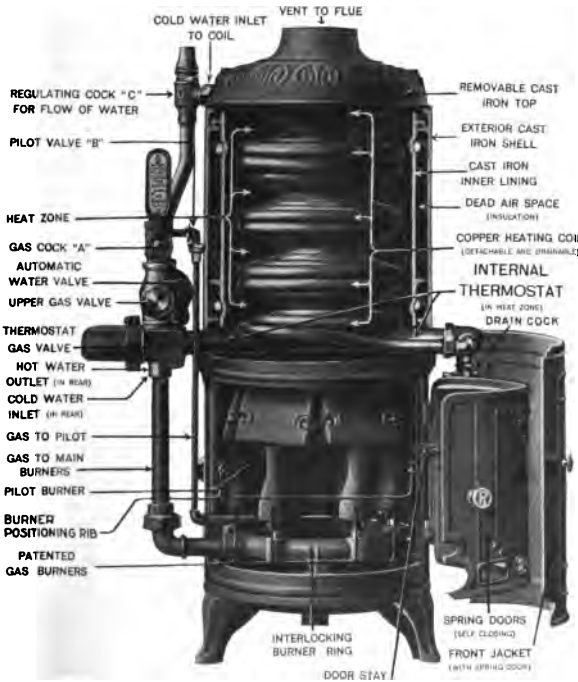
The Aluminum Cottage Water Heaters included in this class represent a very distinct advance in the art of water heater manufacture.

They, for the first time, provide heaters which by their beauty of design, lightness of weight and elegance of finish, are worthy to be placed in bathrooms and kitchens.

This heater having a polished aluminum shell and nickel plated mechanism, presents a very pleasing appearance and harmonizes with high class fixtures wherever it is installed, and, being unusually light, readily connects to wall or other places without troublesome fitting, which is sometimes urged against the cast iron type of Cottage heater.

The Ruud Cottage Water Heater

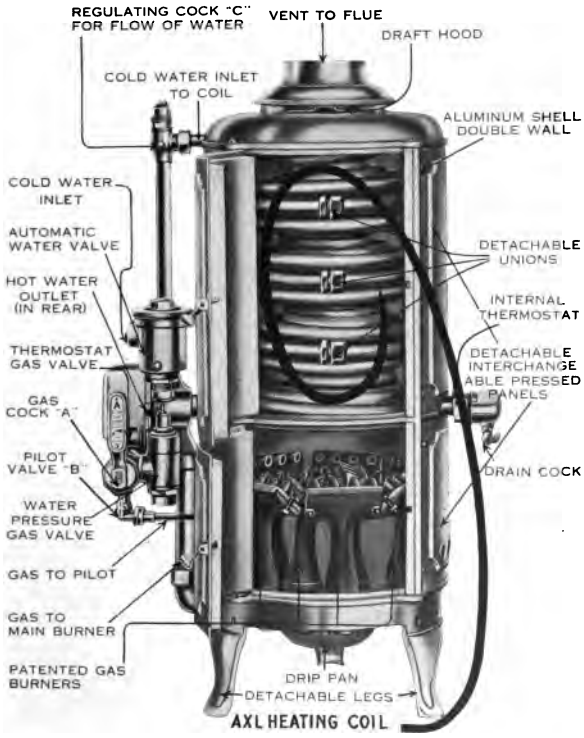
Thermal Valve Model, Type F, Cast Iron. Designed to install on wall brackets or floor



General Features of Construction of the Ruud Cottage Water Heater

Ruud Aluminum Cottage Water Heater

Showing its adaptability for installing on floor or attaching to wall



General features of construction of the Ruud Aluminum Cottage Water Heater

GENERAL TABLE
Rund Instantaneous Automatic Cottage Water Heaters
Cast Iron and Aluminum Models

Size	Per min. capacity	Average temp. rise Nat. Gas	Average temp. rise Art. Gas	Length of coil	Outside diam. of coil	Diam. water valve	Size water inlet	Size water outlet	Water pressure minimum
No. 1½	1½ gal.	80°	63°	45′	⅝″	2″	⅜″	⅜″	20 lb.
No. 2½	2½ gal.	80°	63°	60′	⅝″	2″	⅜″	⅜″	20 lb.
No. 60	1½ gal.	80°	63°	45′	⅝″	2″	⅜″	⅜″	20 lb.
No. 65	2 gal.	80°	63°	55′	⅝″	2″	⅜″	⅜″	20 lb.
No. 70	2½ gal.	80°	63°	65′	⅝″	2″	⅜″	⅜″	20 lb.

Size	Size gas meter	Gas consumed per min.	No. burners	Orifice Nat. Gas	Orifice Art. Gas	Orifice Gasoline Gas	Size gas line	Size flue conn.	Wgt. crated Lbs.	Wgt. net Lbs.
No. 1½	10-L	1½ Cu. Ft.	6	52	40	36	¾″	4″	140	120
No. 2½	10-L	2½ Cu. Ft.	10	52	40	36	¾″	4″	200	175
No. 60	10-L	1½ Cu. Ft.	6	52	40	36	¾″	3″	75	50
No. 65	10-L	2 Cu. Ft.	8	52	40	36	¾″	4″	85	60
No. 70	10-L	2½ Cu. Ft.	10	52	40	36	¾″	4″	100	70

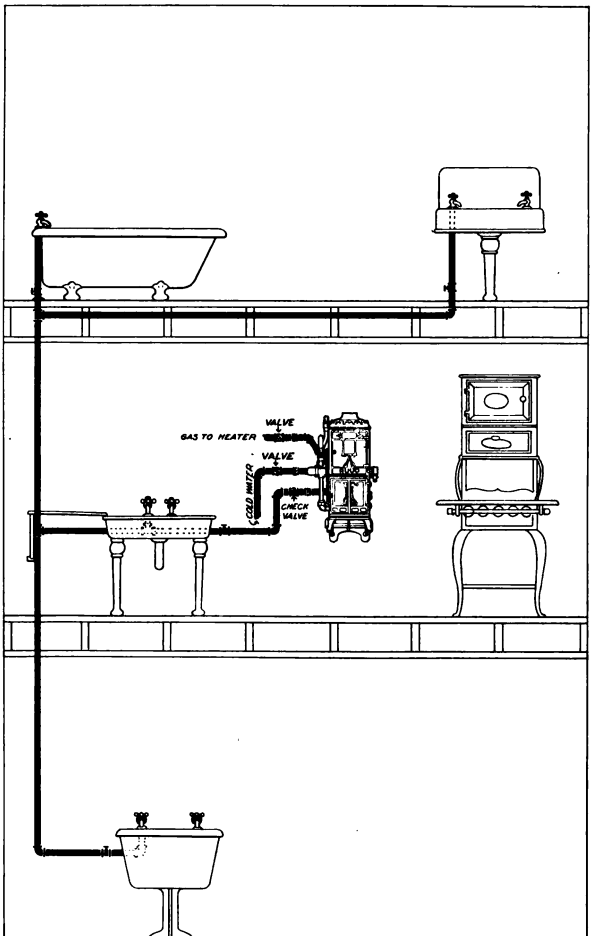
Model Installations

Much that is said under this caption in treating of Type F Ruud might be repeated here, but there are one or two points which should be especially emphasized in the consideration of the sale and installation of Ruud Cottage Heaters.

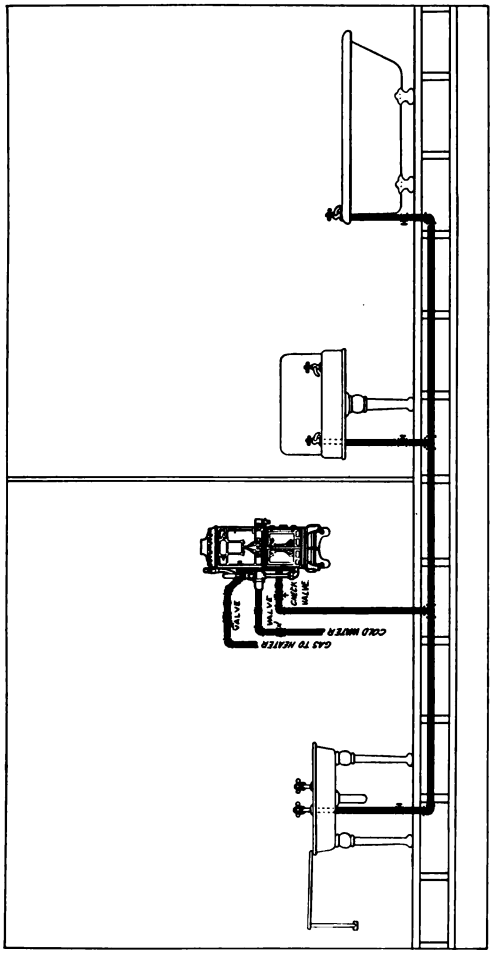
They are small heaters and, while built along the same lines and with the same care and of the same quality of materials as the large Type F Heaters, they are under limitations in their capacity for service inevitable on account of their size. It is extremely important, therefore, that they be not installed under conditions for which they are not suited, or to render a service of which they are not capable.

They should be located as nearly as possible to the point of use of the hot water they are to supply and the hot water line should be just as short and as small in diameter as will deliver the water needed.

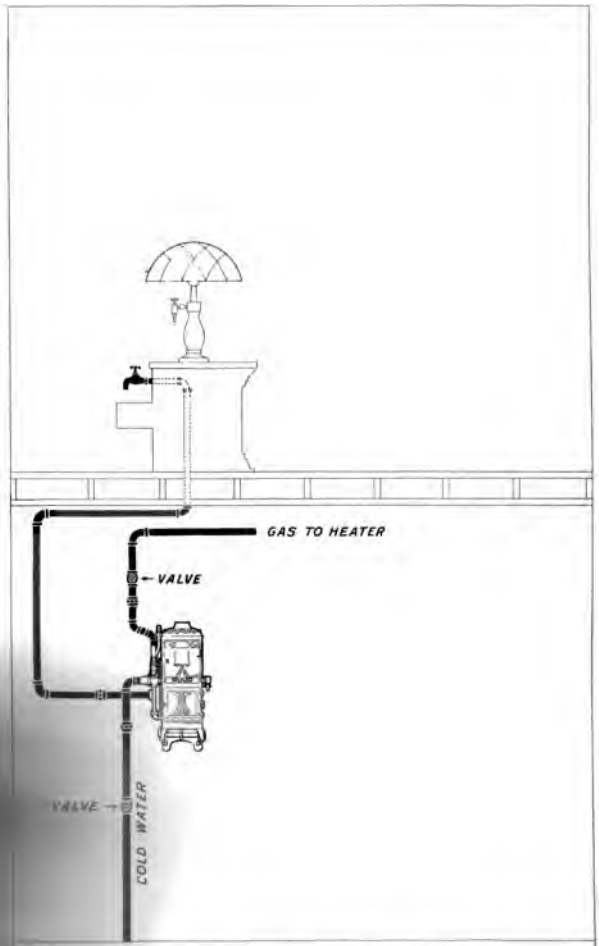
The water pressure conditions are also of utmost importance, and, as this model is not made in low pressure types, the pressure requirements of the Standard Model F Heaters are applicable to the Cottage Type. Twenty pounds pressure per square inch is essential.



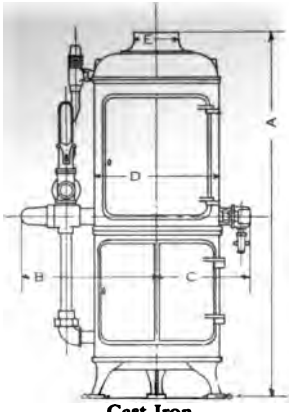
e Ruud Cottage Heater connected in tbe kitchen, close to the ink, and supplying hot water to the bath-room when the pipe is not over twelve feet. In small cottages only



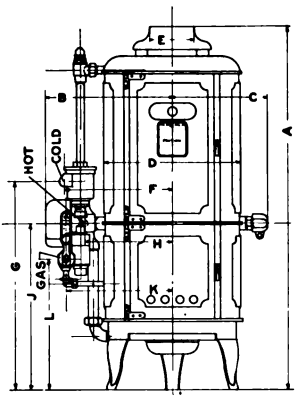
The Ruud Cottage Heater installed in kitchen of apartment supplying the adjoining bath-room



Rund Cottage Water Heater installed for Soda Fountain use. Close to where the water is used. The heater is very efficient. Ever-ready scalding hot water.



Cast Iron



Aluminum

Table of Dimensions

Size	A	B	C	D	E
No. 1½	32½″	12″	8½″	11″	4″
No. 2½	38½″	13½″	9⅛″	12½″	4″

Heater	A	B	C	D	E	F	G	H	J	K	L
No. 60	28¼″	10⅛″	7½″	10¼″	3″	8½″	17¼″	6¾″	13⅝″	8¼″	10⅝″
No. 65	30¾″	10⅞″	8¼″	11¾″	4″	9¼″	17¾″	7½″	14⅛″	9″	11⅛″
No. 70	33″	11¼″	8⅝″	12⅛″	4″	9⅝″	19¼″	8″	15¾″	9½″	12¾″

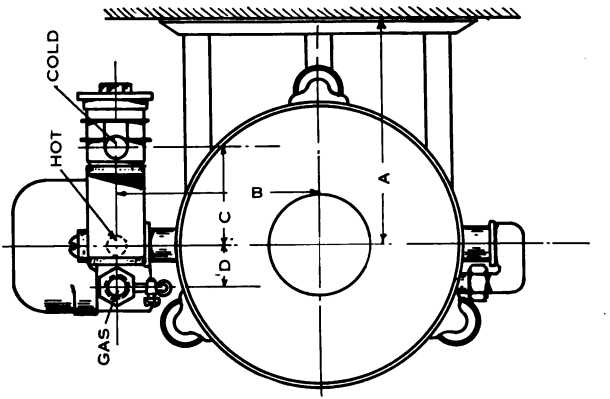
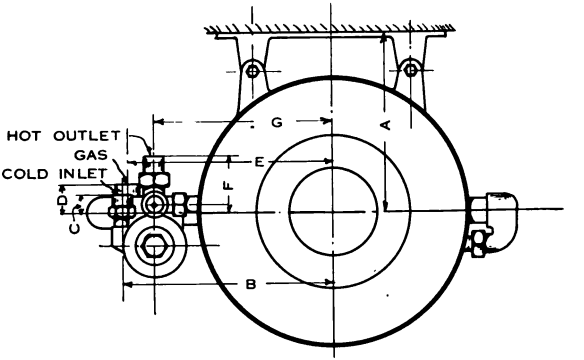


Table of Roughing-In Dimensions

Heater.....	A	B	C	D
No. 1½.....	87/8"	8"	37/8"	15/8"
No. 2½.....	101/2"	9 5/16"	33/8"	21/8"



Heater...	A	B	C	D	E	F	G
No. 60...	7¼"	8½"	1"	1¼"	8¼"	2½"	6¾"
No. 65...	8"	9¼"	1"	1¼"	9"	2½"	7½"
No. 70...	10⅛"	10½"	1"	1¼"	9½"	2½"	8½"

Directions for Setting and Operating the Ruud Cottage Water Heater

To Fit Up Heater

First—Cold water Connection must be made to inlet tagged "Cold," placing union and stop and waste cock in water line close to inlet. Lead male threads only.

Second—Hot Water Connection must be made to outlet tagged "Hot," placing union and check valve in hot water line close to outlet of heater. Lead male threads only.

Third—Always test chimney hole for draft and see that it is clear of obstruction. Make flue connection with full size pipe as specified.

Fourth—Gas connection must be made to inlet tagged "Gas," and must be of size specified in table below. Put gas cock in line.

Fifth—Open every hot water faucet and clear all air from piping. IMPORTANT.

To Start Heater

First—Close Gas Cock "A" and Pilot Cock "B."

Second—Wait two minutes, open valve "B," then light and adjust pilot to a small flame.

Third—Turn Gas Cock "A" full open.

Fourth—Regulate water flow at valve "C" to rated capacity.

Fifth—Regulate gas to proper rate of flow at stopcock.

FITTERS' SPECIFICATIONS

Cottage Heater—Cast Iron

Size	Water Inlet	Water Outlet	Gas Supply	Flue
No. 1½	⅜″	⅜″	¾″	4″
No. 2½	⅜″	⅜″	¾″	4″

Cottage Heater—Aluminum

Size	Water Inlet	Water Outlet	Gas Supply	Flue
No. 60	⅜″	⅜″	¾″	3″
No. 65	⅜″	⅜″	¾″	4″
No. 70	⅜″	⅜″	¾″	4″

Carefully Note

A self-closing faucet placed on kitchen sink prevents waste of hot water, and therefore saves gas.

Examine burners carefully to see that all are placed on spuds before lighting heater.

Heaters for natural, artificial and gasoline gas are alike in every detail except size of orifice emitting gas to the burners.

Be sure that heater is level and has a substantial foundation if on floor, or is firmly fastened to wall.

Always locate heater at nearest available point to where the hot water is to be used most frequently.

Do not place piping where it will interfere with removal of valve caps, lever hood, etc.

Operation

Opening of any hot water faucet will cause gas to automatically ignite at main burners, and a continuous flow of hot water will follow.

Upon closing a faucet the gas will automatically be shut off from main burners, and only the small pilot light will be left burning.

Thermostatic Regulation

The temperature of the hot water is controlled by the thermostat in heater, which is adjusted at factory to [illegible] 140 degrees Fahrenheit. In order to test adjustment, draw water at nearest point to heater at the rate of about one-half the rated capacity of heater per minute, continuously for five minutes. The temperature of the water should now show from 140 degrees Fahrenheit to 150 degrees Fahrenheit, the gas shutting off and on intermittently. If not quite up to this point, turn Tem-

perature Regulating Screw "J" a trifle in to raise the adjustment, and if the temperature shows much above 150 degrees Fahrenheit, turn Regulating Screw "J" a trifle out to lower the adjustment. Be very careful in adjusting the screw, as a trifle of a turn materially alters the change of temperature.

Condensation or "Dripping" from the Coils

In all instantaneous water heaters, especially when first started, a certain amount of condensation or "sweating" takes place. This is caused by the heat from the burners striking the water coils, generating a certain amount of moisture, which drops down between the burners. Users of heaters, also plumbers unacquainted with the above facts, sometimes think there is a leak in the heater, which is a mistake, as all our heaters are tested at factory under a 300 pound water pressure before shipping.

Cleaning of Coils

The coils of the heater should be cleaned once every year, as this adds to the efficiency. The inside of the coil will not (except where water containing lime is used) become encrusted, but the coil should be kept free of carbon on the outside. See "Care and Maintenance of Water Heaters" to remove lime from coils.

To Drain Heater

Turn off cold water supply; open all hot water faucets; then open air plug on vent of regulating cock "C," open drain cock "D." On Aluminum heater a small drain plug is located on the water valve, which should be opened to drain valve.

Installation

Cold Water Supply

The cold water supply should be run to the heater inlet tagged "Cold" and should be of pipe of the same size or larger than the inlet tapping. It is advisable, but not necessary, to have the line run from the cold water main of the house rather than to take it from a cold line supplying a fixture. A union close to the heater inlet and a stop and waste should be placed in this line and the union should be between the heater inlet and the valve.

Hot Water Supply

The hot water line should be run from the outlet of the heater tagged "Hot" and should run by as short a distance as possible to the nearest point on the hot water main or to the fixture to be supplied. This line should have placed in it a check valve and union with the union between the heater and the check valve. This line should not be larger than the outlet tapping of the heater.

Gas Supply

The gas supply should be a line of the size called for in the table and should be run direct from the meter to the heater without any branches. This is important. A range line or line supplying some other appliance should not be used as a supply to the heater. If one line is desired to carry the heater and another appliance it should be run of pipe proportionately larger.

Flue Connections

What is said on this subject on page 24 is applicable here. A good flue connection to the Cottage Heater is

more important, if possible, than to the Type F heaters. Readers are respectfully requested to give a careful reading to the subject of flues as set forth on pages 24 and 25.

Location

The proper location of a Cottage Heater is a subject for careful thought. The pipe contents of cold water that must be displaced before hot water is drawn is so much larger in proportion to the capacity of a Cottage Heater than it is to that of Type F Heaters, that it has a proportionately greater bearing on the successful operation of the heater.

It is especially imperative, therefore, that the heater be located as near as possible to the point of the most frequent use of hot water.

Re-Heating System

Unlike most of the small Instantaneous Heaters on the market the Ruud Cottage Water Heaters, equipped as they are, with the full Ruud Patented Dual Fuel Control Mechanism are capable of being connected on the Re-Heating or Supplementary System as described on pages 29 and 30. This will in many cases permit of even added economy being obtained from them by their connection on this system.

Structural Specifications

Ruud Instantaneous Automatic Cottage Water Heater

SHELL Best grade light grey iron castings. Sectional construction assembly for ease of dismounting. Shell consists of rear shell or back section; upper and lower front sections both carrying spring doors; inner lining of cast iron on upper half of shell and on upper door, providing dead air space for insulation, reducing radiation loss to minimum; top casting and base. Base forms a pan for collection of condensation and is tapped for attachment of permanent drain connection. All parts of shell assembled by heavy bolts as few in number as possible.

COILS Seamless copper tubing, tested to stand hydrostatic pressure of 1000 pounds per square inch, tested again after assembling to 300 pounds per square inch. Coil formed of several helical staggered sections of convenient length joined by brazing or couplings when ordered. In latter case all sections are detachable. Section of coil in fire zone of heavier gauge.

BURNERS Burners are of best grade grey iron castings with separable cap and perforated flat copper flame check. Cap, flame check and mixer casting held firmly as a unit with two brass bolts. Burners are mounted in battery on brass spuds in burner ring or manifold.

Brass bolts and spuds make for ease of dismounting no matter how long in service.

MECHANISM Patented Ruud Dual Fuel Control, consisting of water pressure valve or motor cylinder, operating independent gas valve of simplest construction, Internal Thermostat controlling independent gas valve. The two controls of gas flow, by water and thermostat, entirely independent of each other yet making for a control of the gas instantly responsive to conditions and absolutely safe under all conditions.

Structural Specifications

Ruud Aluminum Cottage Heaters

SHELL Double wall pressed aluminum. Panels interchangeable. Front panel is a door giving full accessibility to coils.

Top, base and draft hood—cast aluminum. Base provided with detachable drip pan.

COILS AXL aluminum alloy tested to 1000 pounds per square inch before coiling, tested after coiling to 300 pounds per square inch. Coil formed by detachable helical staggered sections joined by Evertight unions instantly detachable.

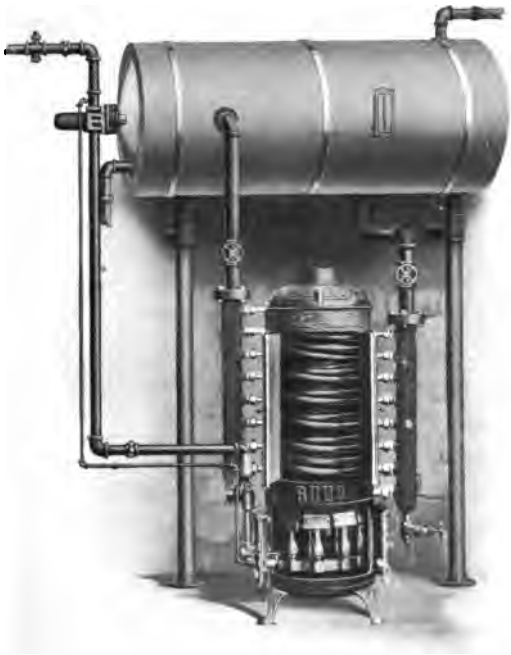
BURNERS Best grade light grey iron castings. Flat copper gauze flame check. Orifices blow torch type. Burners mounted on spuds in base cast integral with burner ring.

MECHANISM Patented Ruud Dual Fuel Control consisting of water pressure valve or motor cylinder, operating independent gas valve. Internal Thermostat controlling separate gas valve of simplest design. The two gas valves, one controlled by water flow and the other by water temperature combined form a positive, safe and economical control of gas under all conditions.

Where the Ruud Cottage Heater can be Used

SMALL COTTAGES
SMALL BUNGALOWS
INDIVIDUAL APARTMENTS
SODA FOUNTAINS
DENTAL OFFICES
BUSINESS OFFICES
PHYSICIANS' OFFICES
CANDY SHOPS
TEA ROOMS
SALOONS
CAFES

And all other places where unlimited hot water is wanted as used through one or more fixtures of small capacity



The Ruud Automatic Multi-Coil Storage System

Protected by United States, British, Canadian, French German and Russian Patents

U. S. PATENTS

Sept. 6, 1898	May 14, 1907
Dec. 30, 1901	Dec. 31, 1907
Feb. 23, 1904	Feb. 25, 1908
May 31, 1904	

and other patents pending

Ruud Automatic Multi-Coil Storage Systems

Ruud Storage Heater
Type J
Ruud Moment Valve

The original Ruud Automatic Storage System was invented by Mr. Edwin Ruud in 1890. The present system thus embodies the results of twenty-five years of development and experience, and has now well-nigh reached the point of perfection.

This system is designed to supply the demand for hot water in large quantities, and to fulfill the severe requirements frequently met in apartment houses, large residences, small hotels, hospitals and, in general, any institution or building where the need for hot water and the conditions surrounding the installation are more than ordinarily exacting.

The principle of the construction and operation of the Ruud Storage System is, in view of the wonderful perfection of service rendered, remarkably simple. The heaviest possible demand for hot water in any particular installation is anticipated and sufficient hot water is stored in a tank to meet this demand, the temperature of the hot water, meanwhile being maintained by the Ruud Multi-Coil Storage Heater controlled, as to its gas consumption by the well known Ruud Thermostatic Moment Valve.

The System is entirely automatic. It operates without any attention and yet renders a service that is the utmost yet attained in luxury and convenience.

Many thousands of these systems are already in use. The following pages treat fully of their construction, [illegible] and use.

Ruud Multi-Coil Storage Heater

Ruud Automatic Multi-Coil Storage Systems

The principle of the operation of this system is the maintenance in a storage boiler of sufficient hot water at a predetermined temperature to supply the anticipated demand.

This result is accomplished by combining, as a unit, a storage boiler of copper, black or galvanized iron, a heater and a controlling mechanism. The standard assembly of the system is illustrated on page 99, but, in practice many variations from this standard combination are possible to suit varied conditions.

The boiler, which should be of sufficient capacity to contain enough hot water to supply the calculated demand, is made of the best grade boiler plate, and tested under a hydrostatic pressure of 250 pounds to the square inch. All seams are carefully rivetted or welded. The boiler furnished with these systems is made strictly to our specifications and is much superior to the ordinary boiler usually found in the open market. A protective coating of either black asphaltum paint or heavy galvanizing is applied, as ordered. Copper boilers are supplied for these systems when ordered. These copper boilers also are built to our specifications and are rigidly tested and guaranteed.

Boilers of 150 gallons capacity and larger are tapped regularly to receive circulators from either two Ruud Storage Heaters, or from one heater and some other source of hot water. Boilers will be furnished fitted with steam coils, hand holes, etc., when so ordered.

The boiler is always required to be covered with an [illegible]ulating covering to prevent heat loss by radiation. This [illegible]ering is shipped with each system.

Ruud Multi-Coil Storage Heater
Spring Doors Open

The Ruud Storage Heater is designed to circulate the water to and from the storage boiler, adding heat to it until the entire contents of the boiler have been heated up to the desired degree.

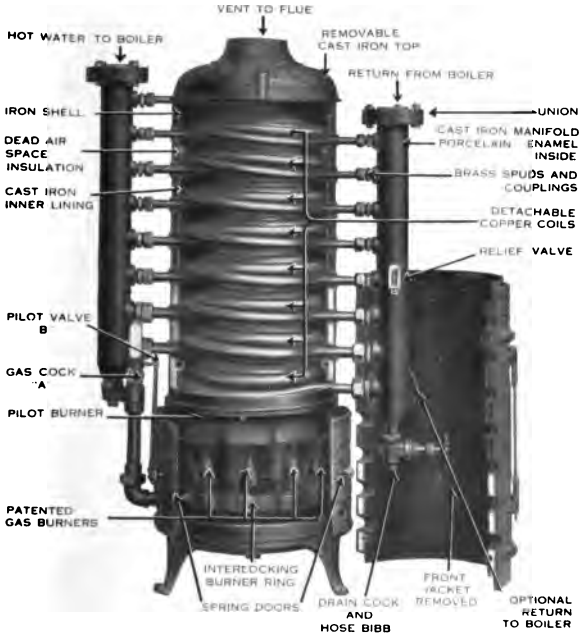
The construction of the heater is such that results are obtained from it in the way of heating efficiency never before hoped for. An efficiency of 65 per cent is guaranteed.

The shell of the heater is of cast-iron interlined to provide a dead air space for insulation.

The burners are standard Ruud burners, with separable caps and removable flat copper gauzes, and are mounted on spuds in a burner ring placed in the lower part of the shell.

The heating surfaces of the Ruud Storage Heaters are wonderfully ingenious in their design. A number of short coils wound in conical spirals are placed one above the other within the upper portion of the heater above the burners. Each of these separate coils terminates in a union joint with the cast iron manifolds placed vertically one on each side of the heater outside of the shell. The coils are so staggered in the heater that no direct gas passage is permitted. The heat is baffled by the coiled tubing through its entire course through the heater. The individual coils are graduated in diameter and length. The lowest coil which is located directly in the flames is of large tubing and short length. Each coil above is successively of smaller tubing and longer length, thus presenting a larger heating surface per unit of water content as the temperature of the gases falls and assuring almost an equality of temperatures attained by the water in each of the coils.

The cast iron manifolds are finished on the inside [illegible] vitreous enamel, preventing any corrosion or rust,



Ruud Multi-Coil Storage Heater, showing General Features of Construction

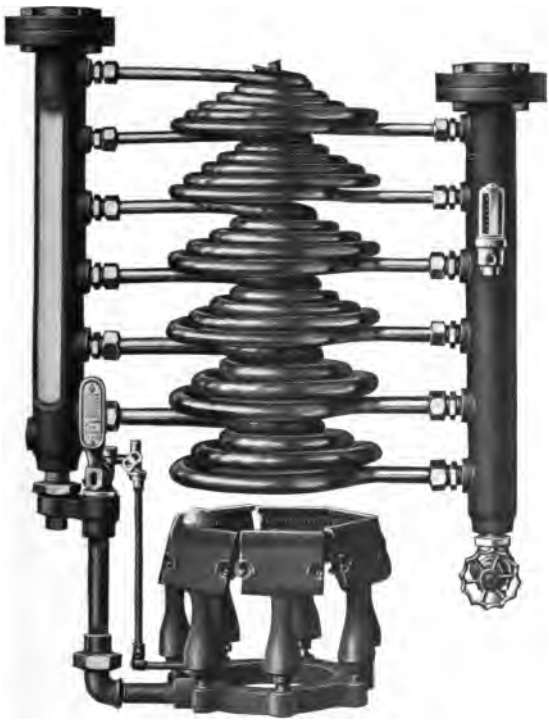
and they are of equivalent cross section to the total cross section area of all the coils, so that at no point is there offered any impediment to free circulation.

The illustrations clearly show the construction described and reveals the further advantages of ease of replacement or removal of any single coil at any time without disturbing the other coils. The feature of eliminating from the fire zone any joints whatever will also be appreciated.

The controlling mechanism is the famous Ruud Thermostatic Moment Valve. This valve, which is a development of the thermostat used in the Instantaneous Automatic Ruud Water Heater, has a construction as simple as it is effective.

A copper expansion pipe immersed in the water in the boiler is the active element. Temperature changes of the water affect this tube causing it to contract or expand. This shortening and lengthening of the tube is transmitted by a porcelain rod contained within it to the multiplying levers at the outer end of the tube. These levers register the change in length of the copper tube with an ingenious arrangement of simple mechanism which causes the gas valve to be opened or closed, as required, with a positive quick motion or snap action. The valve is thus either opened full way or closed tightly at one motion. The importance of this result is such that it may be said to have been almost entirely responsible for the success of the storage system, wherever economy is a consideration.

It is a well recognized principle that to obtain the highest efficiency in any gas heater the rate of gas flow should be maintained at all times at that for which the heater is designed. A gas flow any less results in a marked diminution of the efficiency. Hence a thermostat which gradually closes or opens the gas valve causes the heater



The Anatomy of the Ruud Storage Heater

it controls to operate most of the time at a much lower efficiency than that of which it is capable with a consequent enormous waste of gas. As in the Type F Heaters, a sealed iron hood encloses the levers of the Moment Valve and mechanism to render them safe from accident and prevent tampering by unauthorized persons. The standard assembly of the system, as shown, is the boiler supported in cradles resting on pipe supports, the heater set immediately beneath or in front of the boiler and connected thereto by circulating pipes in which are gate valves (Pipe and valves not furnished as part of the system), the Moment Valve inserted in end of boiler and connected to heater by a main gas line and pilot supply line (Pipe not furnished as part of system), boiler covered with insulating covering as furnished, and thermometer placed in boiler in tapping provided.

In this arrangement it should be noted that in addition to the several advantages pointed out in the construction of the heater, the Moment Valve and the boiler, other points of merit of the utmost importance reveal themselves.

The thermostatic moment valve being placed in the boiler the temperature of the water in the heater has no effect upon it. This does away with the waste of gas resulting from the lighting of the burners at short intervals upon the cooling of the heater, a result inevitable in systems having a thermostat other than the Moment Valve type.

The position of the heater and its coil arrangement eliminate absolutely the cooling effect of the draft of the chimney and setting up of a reversed circulation. The loss of heat from this cause alone in systems having the heater above or contained in the boiler is very great, aggravated by the fact that a continuous draft is maintained through the heater and chimney to which it is connected. Pilot burners of large consumption are necessary in such systems to "Maintain the Temperature."

Showing coils connected into manifold; porcelain enamel coating inside

The operation of the system may be very briefly described. Upon lighting the heater the water in the coils is heated at once, and, following its natural tendency, rises through the circulating pipe to the boiler to be replaced by cold water from the boiler flowing down through the other circulating pipe into the coils. Circulation, having been established, continues until the water in the boiler is heated to the degree for which the Moment Valve is adjusted. When this degree is attained the Moment Valve closes the gas valve with a snap action and the gas is extinguished in the heater. As the temperature in the boiler falls a predetermined number of degrees, generally 25° F.—which, of course, will occur when hot water is drawn at the faucets and replaced by cold water—the Moment Valve will open the gas valve full way. The gas will relight in the heater and continue burning at its greatest efficiency until the water in the boiler is restored to the desired temperature, when the gas will be again shut off by the Moment Valve.

It will be seen that the system constantly maintains the boiler at the temperature desired, within a predetermined limit, the action being entirely automatic.

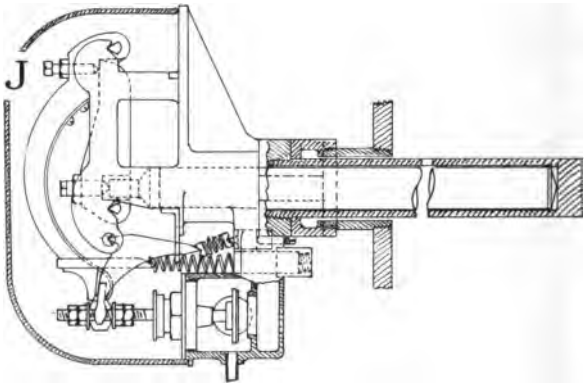
Storage Systems Fitted with Graduating Thermostats

(For Natural Gas Only)

The general description of the construction and operation of the Ruud Multi-Coil Storage Systems outlined in the foregoing pages treat solely of the Ruud Moment Valve as the fuel controlling mechanism. Where natural gas is used, another form of fuel controlling mechanism commonly known as the "Graduating Thermostat" is frequently used.

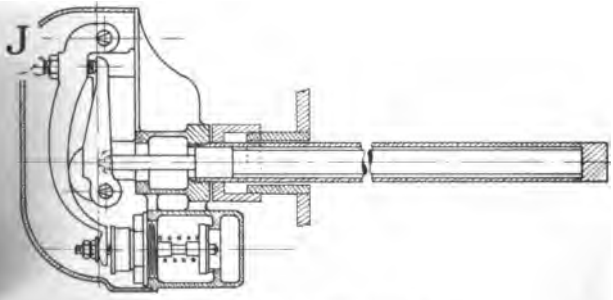
All of the valuable saving features that the Ruud Moment Valve effects in connection with artificial gas are also effected when natural gas is used, but, due to the fact that natural gas is usually sold at such a low rate, less efficient devices are frequently used, which accounts for the use of the Graduating Thermostat.

To clearly differentiate between the two types of control, it is important to note that the Moment Valve is never in a balanced position; that is to say, it is holding the valve full open or fully closed, whereas the Graduating Thermostat will take all the positions between its high and low points of adjustment, and, due to the loss of heat by radiation and convection, can never be said to be completely at rest. When water in a system controlled by a Graduating Thermostat reaches the high point of adjustment it immediately begins to lose some of its heat, even though no water is drawn, and this slight loss of temperature affects the Graduating Thermostat, allowing a small amount of gas to be burned. This fluctuates in accordance with the temperature losses. It is common practice to install a Graduating Thermostat in the manifold of the heater, more out of convenience than efficiency. Where Graduating Thermostats are to be used, it is wisest to install the thermostat in the tank. This considerably increases the capacity of the heater, due to the fact that it eliminates the frequent cutting off of the gas by the thermostat when it is in the manifold.



Ruud Moment Valve

Snap Acting Thermostat



Graduating Thermostat

Conditions for the Best Service

The extreme adaptability to various conditions of the Ruud Automatic Multi-Coil Storage System is one of its greatest advantages. The remarks made on pages 12 and 13 do nevertheless, apply to this system, but more especially in respect to the economy of its operation.

The storage system, on account of its different principle of operation, takes but little account of water pressure. Wherever the cold water will flow an equal flow of hot water may be expected, providing, however, that the piping is ample. Since any number of faucets can be supplied at once from the Storage System, larger piping may be used to deliver the hot water. In short, the piping for hot water delivery from the storage System may be designed with reference only to the fixtures to be supplied, without any reference to the heater, bearing in mind, however, that piping larger than necessary is detrimental to the economical operation of any system of hot water generation, be the fuel used what it may.

If the table of requirements for gas supply be followed there is no trouble to be anticipated from this source.

The flue conditions are of utmost importance in connection with Automatic Storage Systems. It is absolutely essential that the flue to which the heater is connected have a good draft at all times. Unless this can be had with certain assurance, the installation should not be made.

In locating the heater the cardinal rule of favoring the point of most frequent use should be followed.

The Application of Ruud Multi-Coil Storage Systems to Residences

Ruud Multi-Coil Automatic Storage Systems are made in many combinations. (See pages 112 and 113). The Systems are also furnished in Duplex Storage Systems, having two heaters in combination with one boiler, and having correspondingly greater capacity. (See page 114).

The heaters are made in the following five sizes: Number One Hundred, Number Two Hundred, Number Three Hundred, Number Four Hundred and Number Five Hundred, the size number of the heater giving its rated capacity per hour with a 63 degree raise in temperature with artificial gas or 75 degrees with natural gas. (See Capacities of Heaters, page 195).

The Moment Valves are made in three sizes: One inch, one and a half inches and two inches. (See page 114).

No table can be set down that can assume to be an absolute guide in every case. Individual installations of apparently the same requirements vary widely in practice. As suggestions we give below a table that our experience would indicate to be, in the main, a safe rule to apply unless special conditions would warrant departing from it.

100 Gallon per Hour Heater, with 100 or 150 Gallon Boilers.	Large residences having three to five bath rooms, bed room lavatories, large kitchen sink, pantry sink and laundry. Flat buildings with six apartments of four or five rooms each.
200 Gallon per Hour Heater with 150, 200 or 250 Gallon Boilers.	Large residences having five to eight bath rooms, large kitchen sink, pantry sink, dish washing machine, large laundry. Apartment buildings having six to twelve flats of five or six rooms each.

300 Gallon per Hour Heater, with 250, 300 or 365 Gallon Boilers.	Large residences having seven to ten bath rooms, large kitchen sink, pantry sink, dish washing machine, large laundry. Apartment buildings having ten to eighteen flats of five or six rooms each.
400 Gallon per Hour Heater, with 365 or 425 Gallon Boilers.	Large apartment buildings having eighteen to twenty-four flats of five, six or seven rooms. Very large city homes. Thirty to fifty room hotels.
500 Gallon per Hour Heater, with 425, 500 or 600 Gallon Boilers.	Apartment buildings having twenty to thirty flats of five, six or seven rooms each. Very large city homes. Forty to sixty room hotels.

Larger requirements may be met by using what are known as Duplex Storage Systems, in which two or more Multi-Coil Storage Heaters are connected to a single boiler of proper storage capacity.

Ruud Multi-Coil Automatic Storage Systems

Installation

First—Securely fasten Boiler Supports and place Boiler in Saddles and insert Moment Valve and Thermometer.

Second—Set Heater and make connections between it and boiler in exact accordance with table on page 90. Gate valves may be inserted in circulators, if desired to facilitate cleaning or disconnecting heater.

Third—Make gas connection to Moment Valve and between Moment Valve and Heater in exact accordance with table on page 90.

Fourth—Make water connections to and from the Boiler.

Fifth—Make connection, in accordance with table on page 90 from Heater to flue having a good draft, making sure that the flue is clear of obstructions. Place Draft-Hood in flue connection in vertical position. Do not put a damper in the flue connection.

Sixth—Apply insulation furnished with system.

Special Additional Instructions Only for Natural Gas Installations

First—Gas Regulator, furnished with system, must be placed in gas line leading to Heater, and the vent on the Regulator connected to chimney or outside of building.

Second—Insulation for boiler is optional on Natural Gas Systems, but is strongly recommended, as it reduces operating cost.

Third—Storage systems installed on Natural Gas will operate with Ruud Thermostatic Moment Valve or Ruud Graduating Thermostat.

To Start System

First—See that the boiler and system are full of water and free of air, also that valves on circulators, if put in, are full open.

Second—See that gas cock "A" is closed before opening gas valve in gas line leading to heater.

Third—Open pilot valve "B" and light pilot. Regulate to a small flame.

Fourth—Turn Gas Cock "A" full open.

Fifth—Regulate gas to proper rate of flow at gas cock.

Carefully Note

Self closing faucets on kitchen sinks or other frequently used fixtures prevent waste of water and therefore save gas.

Examine burners carefully before lighting heater to see that all are properly placed on spuds.

Be sure that the system is level and has a substantial foundation.

Set system as close as practicable to the point where hot water will be used most frequently.

Do not run piping in such a way that it interferes with removal of parts of heater or Moment Valve.

Operation

After starting the system as described, the heater will operate continuously until the boiler is filled with hot water up to the temperature at which the thermostat is adjusted, usually 140 degrees.

With a Graduating Thermostat, sometimes used on natural gas, the main burners will light up intermittently, or just as often as is necessary to keep the temperature of the water in the boiler up to the temperature at which the thermostat is set.

With systems fitted with the Thermostatic Moment Valve, the heater will operate full until the boiler is brought to the temperature at which the valve is set when valve will close and remain full off until the temperature of the water in central part of the boiler has fallen at least 25 degrees, when the valve will open full and the heater operate continuously until the temperature in boiler is brought up to that for which the valve is adjusted.

To Regulate Thermostat

The Thermostat is adjusted in factory to close off at a temperature of 140 degrees Fahrenheit. Should a higher temperature be desired, remove the hood from thermostat and turn regulating screw "J" a trifle in. Be careful in adjusting the screw, as a trifle of a turn materially changes the temperature. The hood covering the thermostat should always be in place.

Fitter's Specifications for all Sizes of Systems

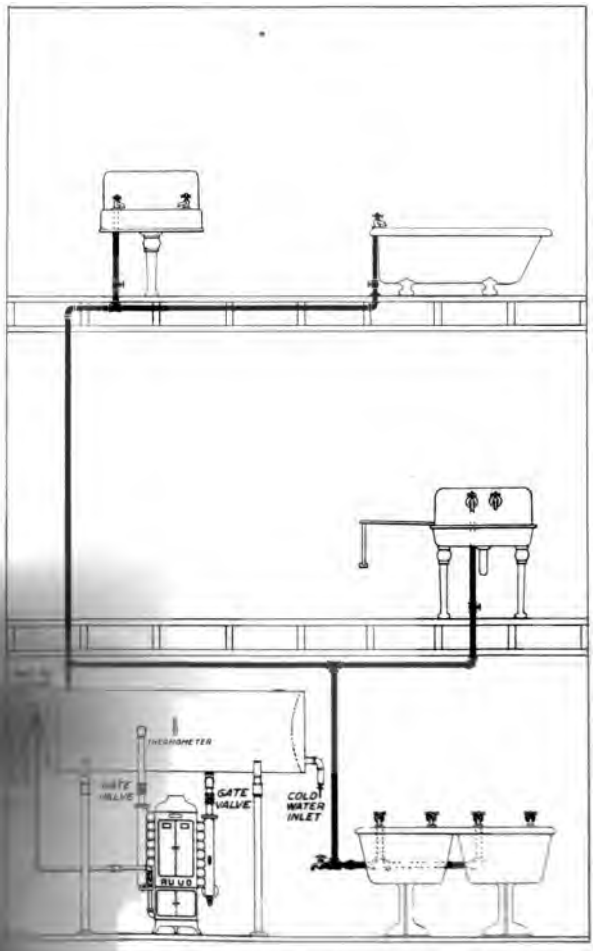
Size of Heater.....	No. 100	No. 200	No. 300	No. 400	No. 500
Size of Circulating Pipes	1½″	2″	2″	2½″	2½″
Size of Gas Connection	¾″	1″	1″	1½″	1½″
Size of Cold Water Supply (not less than)...	1″	1″	1¼″	1½″	2″
Size of Flue Connection	4″	6″	6″	7″	8″
Size of Gas Meter.....	20 Lt.	30 Lt.	45 Lt.	60 Lt.	80 Lt.

When two or more heaters are connected to the same boiler the same schedule for each individual heater applies.

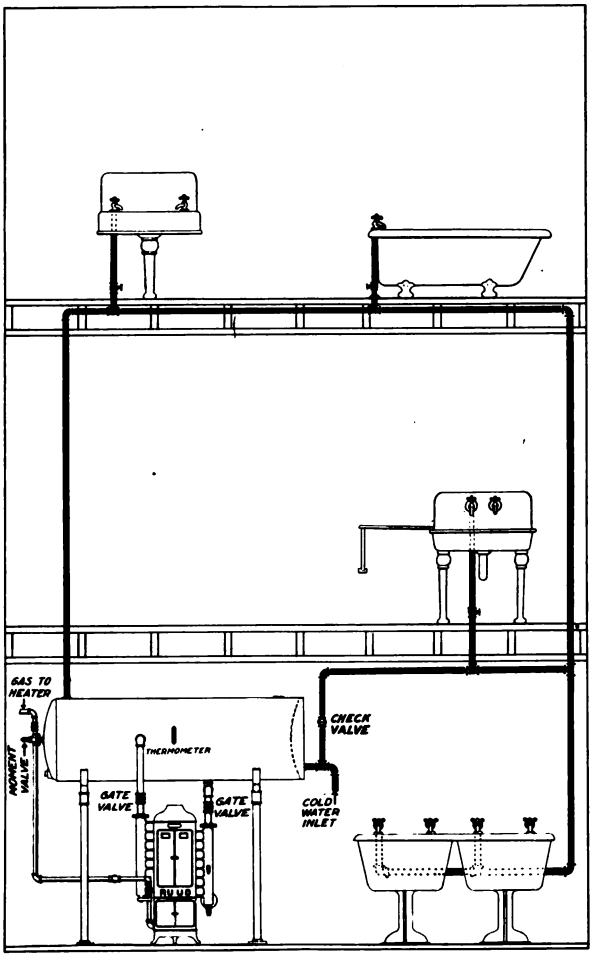
Model Installations

The Ruud Multi-Coil Automatic Storage Systems may be installed under many different conditions.

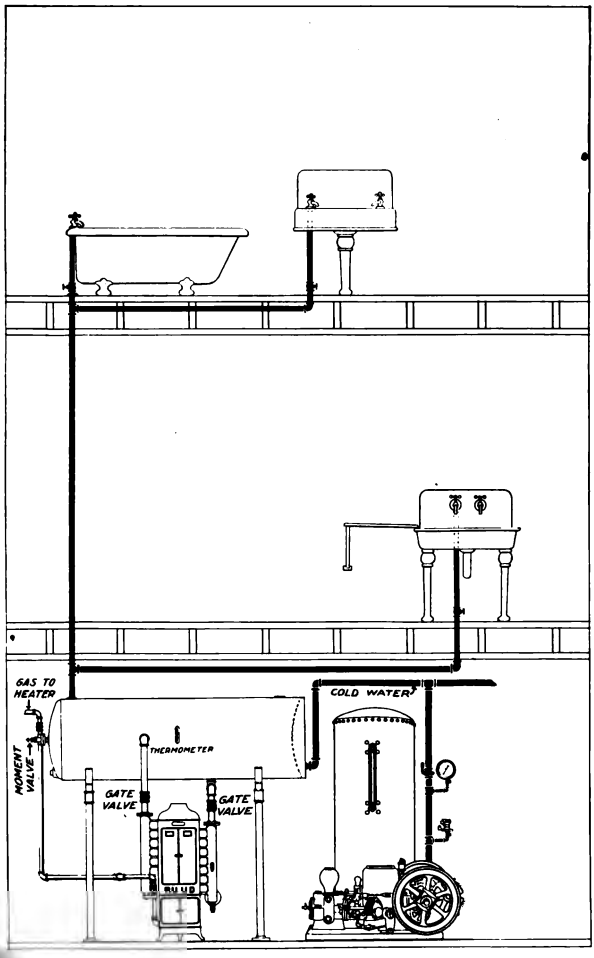
The Installations shown on the following pages are those most commonly met.



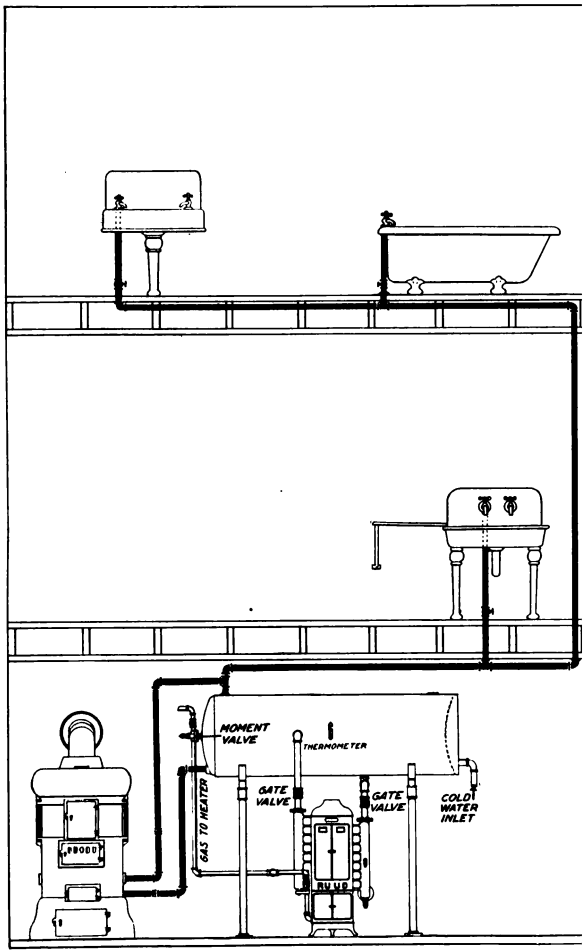
Tank Storage System installed on Direct System of Plumbing, supplying hot water all over the house



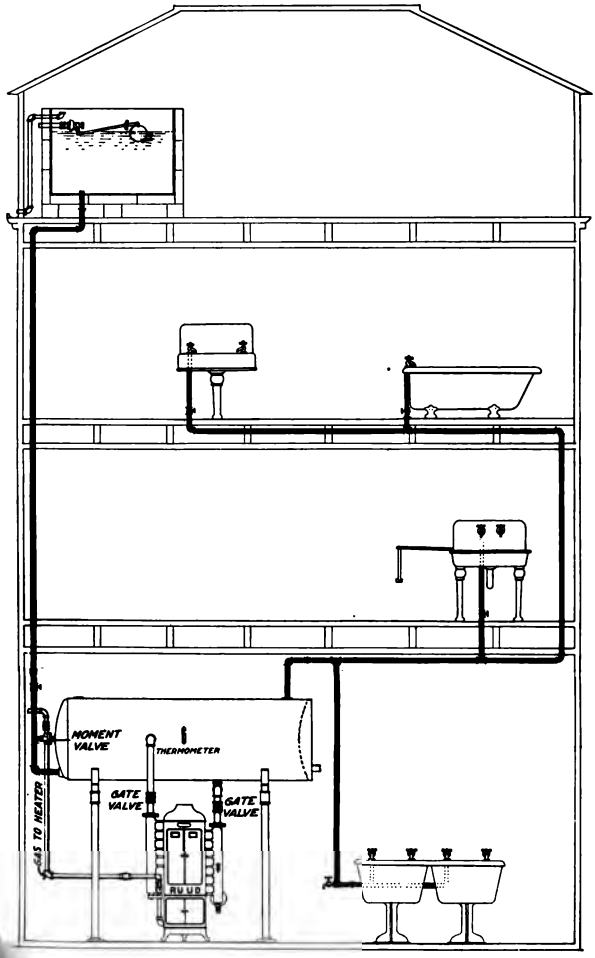
Ruud Storage System installed on Return Circulation System of Plumbing



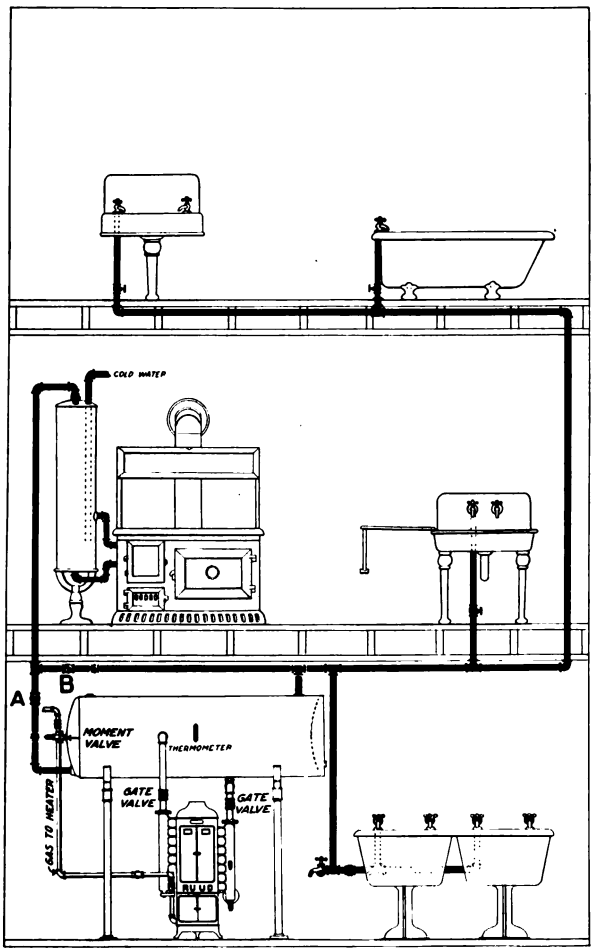
Ruud Storage System installed on Direct System of Plumbing, water supplied under pressure of pneumatic tank



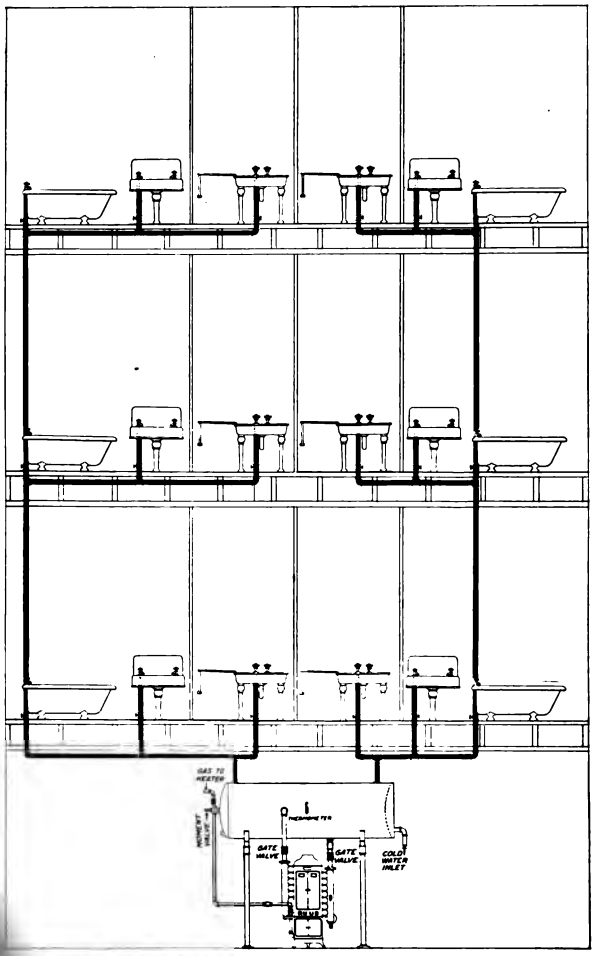
Ruud Storage System with Auxiliary Heating Coil or Water-Back in Heating Plant



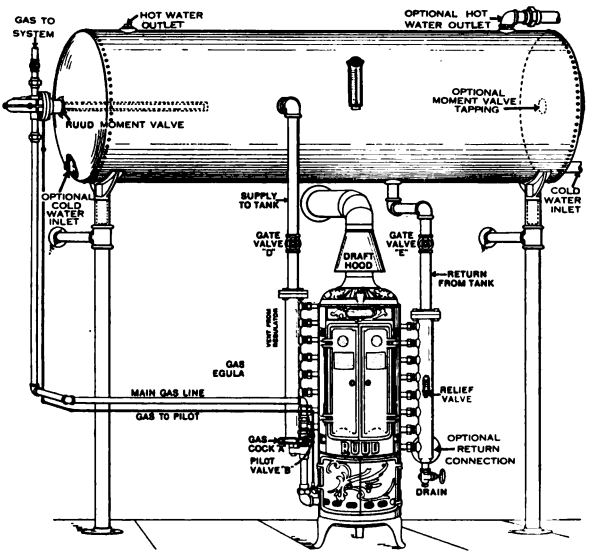
Ruud Storage System installed on Direct System of Plumbing, water supplied from Attic Tank



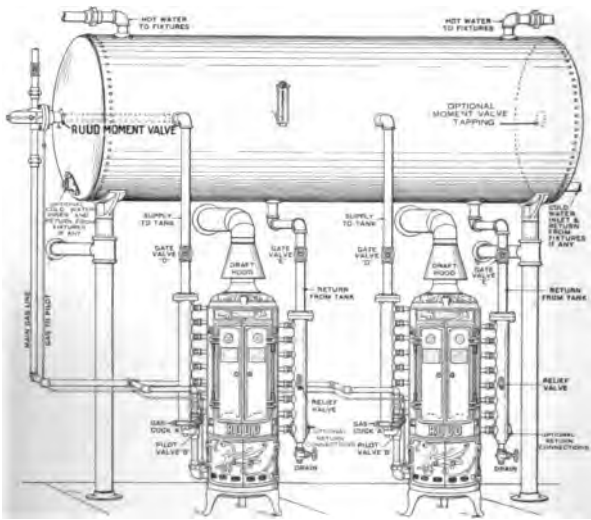
Ruud Storage System installed on Re-Heating System in connection with Range Boiler



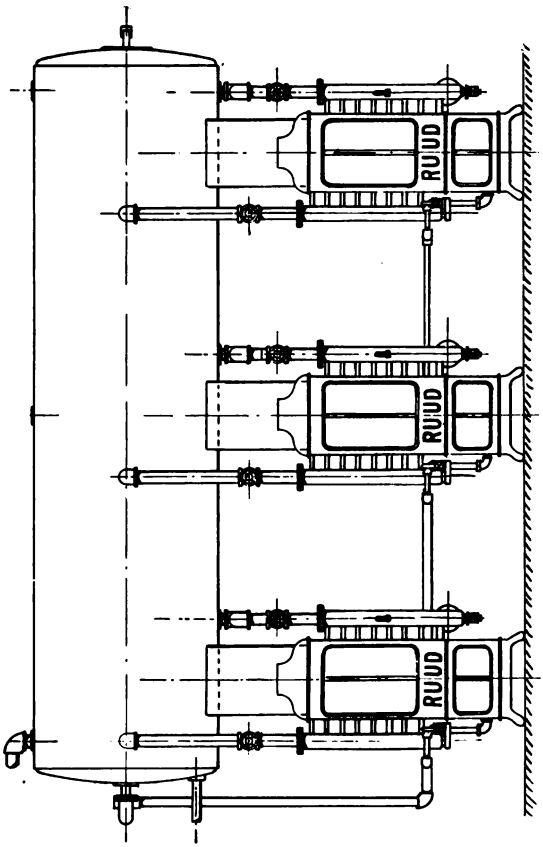
Ruud Storage System installed in Apartment Building



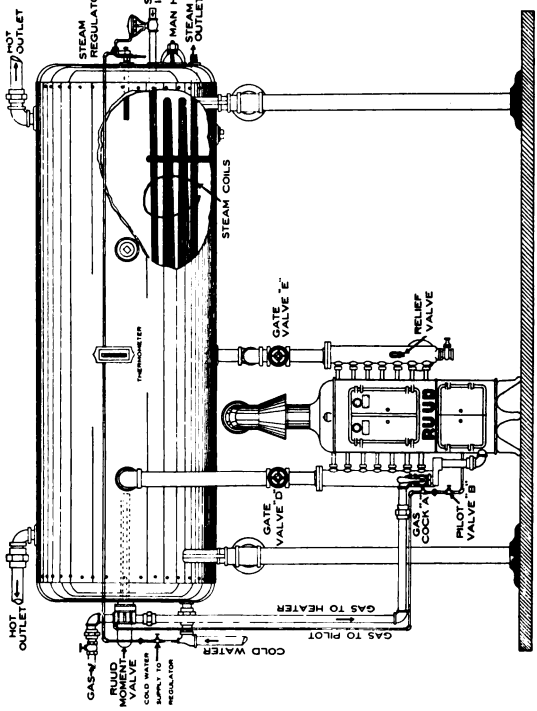
Showing Installation—Standard Assembly Single System



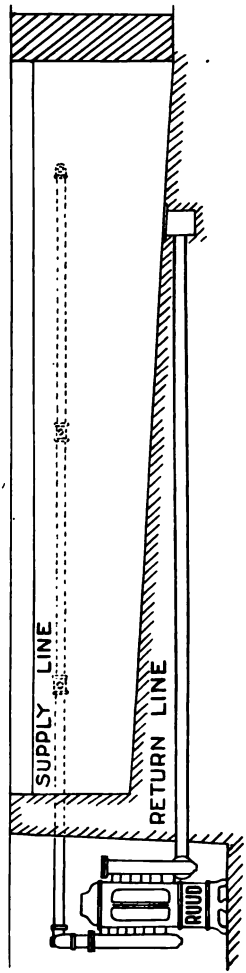
Showing Installation—Standard Assembly Duplex System



Showing Installation—Standard Assembly, Triplex System



Standard Assembly, Ruud Storage System
Steam Coils in Tank



Swimming Pool—Natural Gas only

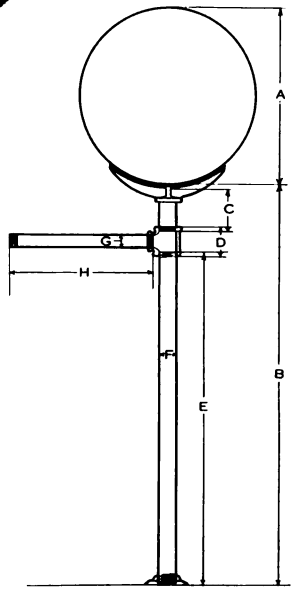
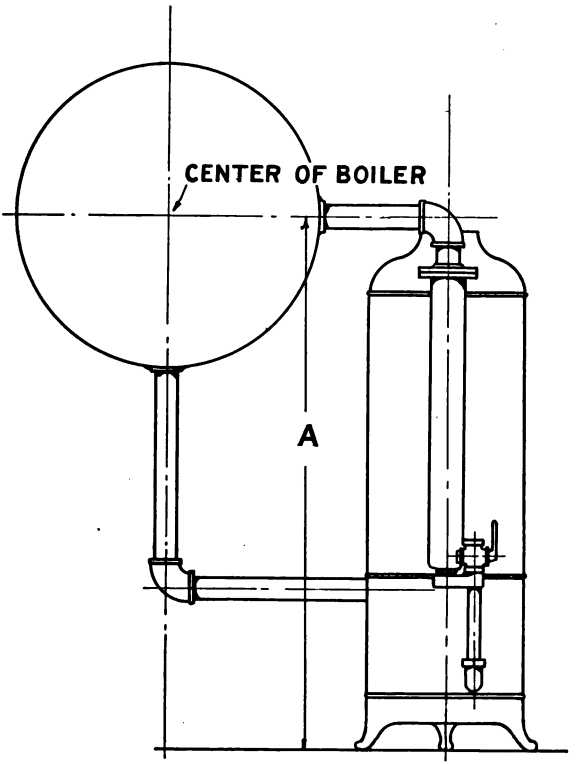


Table of Standard Sizes of Boiler Supports

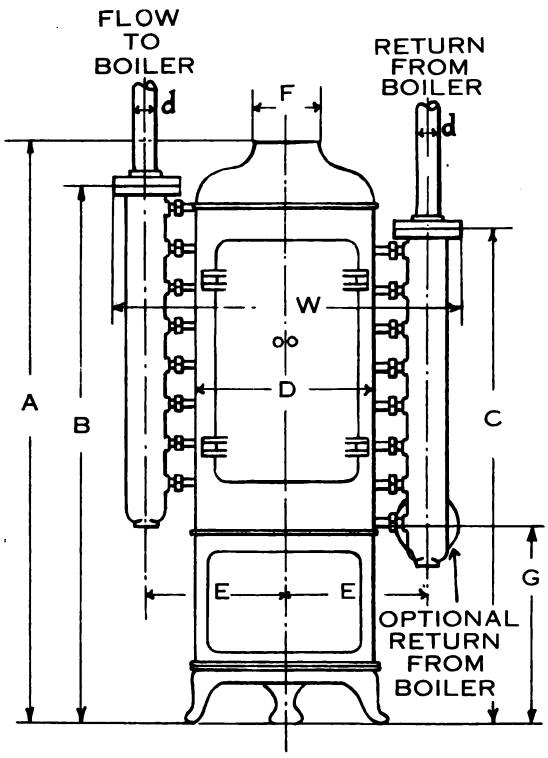
Size of Boiler		80 100	100	150 200	250 365	365	425 500	425 500	600	600	700	800
No. Htr. Used		100	200	100 200	300	400	400	500	400	500	500	500
Diameter Boiler	A	20″ 22″	22″	24″	30″	30″	36″	36″	42″	42″	42″	48″
Ht. floor to boiler	B	56″	56″	54″	54″	60″	60″	62″	60″	62″	62″	62″
Sht. Nipple thread one end	C	5½″	5½″	5½″	5½″	5½″	5½″	5½″	5½″	5½″	5½″	5½″
Length of Tee	D	3½″	3½″	4½″	4½″	4½″	4½″	4½″	5″	5″	5″	5″
Length of pipe for standard	E	47½″	47½″	41½″	41½″	47½″	47½″	49½″	47½″	49½″	49½″	49½″
Size of pipe	F	1½″	1½″	2″	2½″	2½″	2½″	2½″	3″	3″	3″	3″
Size of pipe for brace	G	1″	1″	1¼″	1½″	1½″	1½″	1½″	2″	2″	2″	2″
Length of Brace	H	18″	18″	20″	24″	24″	27″	27″	30″	30″	30″	33″



Roughing-In Dimensions

Heater	No. 100	No. 200	No. 300	No. 400	No. 500
A	47″	53″	56″	63″	66″

NOTE—Heights of Boilers on supports shown are minimum. The boiler should be placed as close to ceiling as possible



Ruud Storage Heater Dimensions

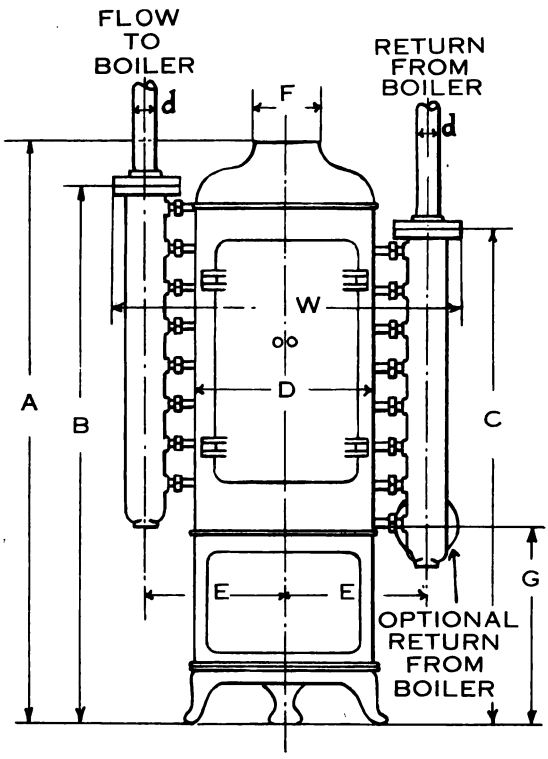
No.	A	B	C	D	E	F	G	d	W
100	45″	41 ¾″	37 ¾″	12 ½″	10 ¾″	4″	17 ¼″	1 ½″	27″
200	49 ⅞″	46 ⅜″	42 ½″	14″	11 ¾″	6″	17 ½″	2″	29 ½″
300	53 ⅜″	49 ½″	45 ½″	16″	13″	6″	18″	2″	32″
400	61″	56 ¼″	52″	18 ½″	14 ¾″	7″	19″	2 ½″	36 ½″
700	64 ⅛″	58 ½″	53 ½″	20 ½″	15 ¾″	8″	18 ½″	2 ½″	38 ½″

General Table

Ruud Multi-Coil Storage Heaters

Size	Per hour capacity—gallons	Average Temp. Rise Nat. Gas	Average Temp. Rise Art. Gas	No. of Coil Sections	Diameter of Tubing	Length of Tubing	Size Manifold Connection	Size Gas Line	Size Flue Connections
100	100	75°	63°	4	¾″	9′ 0″	1½	¾″	4″
				1	⅞″	7′ 4″			
				1	⅞″	5′ 2″			
200	200	75°	63°	3	¾″	9′ 6″	2	1″	6″
				2	⅞″	10′ 6″			
				2	1″	8′ 6″			
300	300	75°	63°	2	¾″	14′ 1″	2	1″	6″
				2	⅞″	11′ 0″			
				2	1″	9′ 4″			
				2	1⅛″	9′ 6″			
400	400	75°	63°	2	⅞″	15′ 2″	2½	1½″	7″
				2	1″	13′ 0″			
				2	1⅛″	10′ 4″			
				2	1¼″	10′ 5″			
500	500	75°	63°	2	⅞″	16′ 3″	2½	2″	8″
				2	1″	14′ 0″			
				2	1⅛″	14′ 6″			
				1	1¼″	14′ 0″			
				1	1¼″	11′ 3″			

Size	No. of Burners	Orifice Nat. Gas.	Orifice Art. Gas	Orifice Gasoline Gas	Moment Valve Required	Gas Consumed Per Hour	Size Gas Meter	Weight Crated (lbs.)	Weight Net (lbs.)
100	10	52	40	36	1″	120	20	325	233
200	12	52	40	36	1″	210	30	410	333
300	15	52	40	36	1½″	300	45	510	410
400	24	52	40	36	1½″	400	60	675	602
500	30	52	40	36	2″	500	80	895	683



Ruud Storage Heater Dimensions

No.	A	B	C	D	E	F	G	d	W
100	45″	41 ¾″	37 ¾″	12 ½″	10 ¾″	4″	17 ¼″	1 ½″	27″
200	49 ⅛″	46 ⅜″	42 ½″	14″	11 ¾″	6″	17 ½″	2″	29 ½″
300	53 ⅜″	49 ½″	45 ½″	16″	13″	6″	18″	2″	32″
400	61″	56 ¼″	52″	18 ½″	14 ¾″	7″	19″	2 ½″	36 ½″
500	64 ⅛″	58 ½″	53 ½″	20 ½″	15 ¾″	8″	18 ½″	2 ½″	38 ½″

General Table

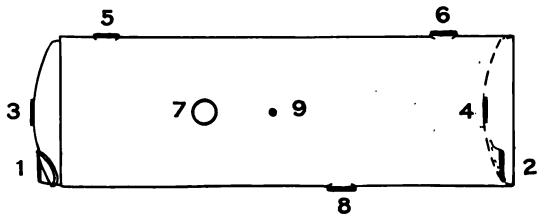
Ruud Multi-Coil Storage Heaters

Size	Per hour capacity—gallons	Average Temp. Rise Nat. Gas	Average Temp. Rise Art. Gas	No. of Coil Sections	Diameter of Tubing	Length of Tubing	Size Manifold Connection	Size Gas Line	Size Flue Connections
100	100	75°	63°	4 1 1	¾" ⅞" ⅞"	9' 0" 7' 4" 5' 2"	1½	¾"	4"
200	200	75°	63°	3 2 2	¾" ⅞" 1"	9' 6" 10' 6" 8' 6"	2	1"	6"
300	300	75°	63°	2 2 2 2	¾" ⅞" 1" 1⅛"	14' 1" 11' 0" 9' 4" 9' 6"	2	1"	6"
400	400	75°	63°	2 2 2 2	⅞" 1" 1⅛" 1¼"	15' 2" 13' 0" 10' 4" 10' 5"	2½	1½"	7"
500	500	75°	63°	2 2 2 1 1	⅞" 1" 1⅛" 1¼" 1¼"	16' 3" 14' 0" 14' 6" 14' 0" 11' 3"	2½	2"	8"

Size	No. of Burners	Orifice Nat. Gas.	Orifice Art. Gas	Orifice Gasoline Gas	Moment Valve Required	Gas Consumed Per Hour	Size Gas Meter	Weight Crated (lbs.)	Weight Net (lbs.)
100	10	52	40	36	1"	120	20	325	233
200	12	52	40	36	1"	210	30	410	333
300	15	52	40	36	1½"	300	45	510	410
400	24	52	40	36	1½"	400	60	675	602
500	30	52	40	36	2"	500	80	895	683

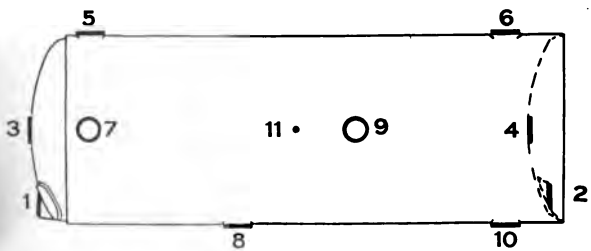
Ruud Standard Storage Boilers

Showing the number of tappings for Single System and how each is used



No. 1—Cold Water Inlet and optional return from Fixtures, if any.
No. 2—Optional Cold Water Inlet and return from Fixtures, if any.
No. 3—Moment Valve or Graduating Thermostat.
No. 4—Optional opening for Moment Valve or Graduating Thermostat.
No. 5—Hot Water Outlet to Fixtures.
No. 6—Optional Hot Water Outlet to Fixtures.
No. 7—Hot Circulator from Heater.
No. 8—Return Circulator to Heater.
No. 9—Thermometer.

Showing the number of tappings for Duplex System and how each is used



No. 1—Cold Water Inlet and optional return from Fixtures, if any.
No. 2—Optional Cold Water Inlet and return from Fixtures, if any.
No. 3—Moment Valve or Graduating Thermostat
No. 4—Optional opening for Moment Valve or Graduating Thermostat.
No. 5—Hot Water Outlet to Fixtures.
No. 6—Optional Hot Water Outlet to Fixtures.
No. 7—Hot Circulator from Heater.
No. 8—Return Circulator to Heater.
No. 9—Hot Circulator from Heater.
No. 10—Return Circulator to Heater.
No. 11—Thermometer.

Actual photograph of Ruud Standard Iron Boiler as supplied with Multi-Coil Storage Systems
Note the very heavy, rigid construction

Structural Specifications

Ruud Multi-Coil Storage Heaters

SHELL Best grade light grey iron castings. Sectional construction assembly for ease of dismounting. Shell consists of rear shell or back section, carrying double spring doors on upper half; upper and lower front sections both carrying double spring doors; inner lining of cast iron on upper half of shell and on upper doors, providing dead air space for insulation, reducing radiation loss to minimum; top casting and base. Base forms pan for collection of condensation and is tapped for attachment of permanent drain connection. All parts of shell assembled by heavy bolts as few in number as possible.

COILS Seamless copper tubing tested to 1000 pounds per square inch, tested again after assembling to 300 pounds per square inch. Individual coils in conical spirals connecting to manifolds with ground seat unions.

MANIFOLDS Cast iron, finished on interior with vitreous enamel resisting rust and corrosion.

BURNERS Burners are of best grade grey iron casting with separable cap and perforated flat copper flame check. Cap, flame check and mixer casting held firmly as a unit with two brass bolts. Burners are mounted in battery on brass spuds in burner ring or manifold.

Brass bolts and spuds make for ease of dismounting no matter how long in service.

Ruud Multi-Coil Automatic Storage System

The systems as furnished in the following combinations consist of and include:

For Natural Gas—Ruud Multi-Coil Storage Heater, Boiler, Boiler-Supports, Thermometer, Gas Regulator, Ruud Draft Hood and Magnesia Covering Material for Boiler.

For Artificial Gas—Ruud Multi-Coil Storage Heater, Boiler, Boiler-Supports, Thermometer, Ruud Thermostatic Moment Valve, Ruud Draft Hood and Magnesia Covering Material for Boiler.

Boilers are equipped when so ordered and at an extra price, with Man-hole or Hand-hole, Steam-Coils of either Galvanized Iron or Copper, Special Tappings, etc.

Boiler Saddles and Standards or Supports are furnished with systems having boilers up to and including 500 gallons capacity.

The piping between the Moment Valve and Heater, the Circulators between the Boiler and Heater, are not furnished by us.

Storage Combinations Regularly Made

And Description of Black Iron and Galvanized Iron Boilers

Heater Number	Capacity of Boiler, in gals.	No. of Boiler	Dia. of Boiler	Lgth. of Boiler	No. of Heaters Tapped For	Cold Inlet to Boiler	Hot Outlet from Boiler	Size Circulators	Thickness of Boiler	
									Shell	Head
100	80	1	20″	5′ 0″	1	1¼″	1¼″	1½″	¼″	5/16″
100	100	2	22″	5′ 0″	1	1¼″	1¼″	1½″	¼″	5/16″
100	150	4	24″	6′ 4″	1	1¼″	1¼″	1½″	¼″	5/16″
200	100	5	22″	5′ 0″	1	1¼″	1¼″	2″	¼″	5/16″
200	150	7	24″	6′ 4″	2	2″	1½″	2″	¼″	5/16″
200	200	8	24″	8′ 6″	2	2″	1½″	2″	¼″	5/16″
200	250	9	30″	7′ 0″	2	2″	1½″	2″	¼″	5/16″
200	300	10	30″	8′ 0″	2	2″	1½″	2″	¼″	5/16″
300	200	11	24″	8′ 6″	2	2″	2″	2″	¼″	5/16″
300	250	12	30″	7′ 0″	2	2″	2″	2″	¼″	5/16″
300	300	13	30″	8′ 0″	2	2″	2″	2″	¼″	5/16″
300	365	15	30″	10′ 0″	2	2″	2″	2″	¼″	5/16″
400	300	16	30″	8′ 0″	2	2½″	2½″	2½″	¼″	5/16″
400	365	17	30″	10′ 0″	2	2½″	2½″	2½″	¼″	5/16″
400	425	18	36″	8′ 0″	2	2½″	2½″	2½″	¼″	5/16″
400	500	19	36″	9′ 6″	2	2½″	2½″	2½″	¼″	5/16″
400	600	20	42″	8′ 6″	2	2½″	2½″	2½″	5/16″	7/16″
500	425	21	36″	8′ 0″	2	2½″	2½″	2½″	¼″	5/16″
500	500	22	36″	9′ 6″	2	2½″	2½″	2½″	¼″	5/16″
500	600	23	42″	8′ 6″	2	2½″	2½″	2½″	5/16″	7/16″
500	700	24	42″	10′ 0″	2	2½″	2½″	2½″	5/16″	7/16″
500	800	25	48″	8′ 6″	2	2½″	2½″	2½″	5/16″	7/16″
500	1000	26	54″	8′ 6″	2	2½″	2½″	2½″	5/16″	7/16″

Boilers should be ordered by number.

Boilers are equipped when so ordered with Galvanized Iron, Copper or Brass Steam Heating Coils and Hand-Holes or Man-Holes. (See page 113, Steam Coils)

Automatic Steam Regulators for Coils, furnished on order, are made in the following sizes:

Size Valve	Size Boiler
1″	100– 200 Gal.
1¼″	250– 365 Gal.
1½″	425– 600 Gal.
2″	700–1000 Gal.

Storage Combinations Regularly Made and Description of Copper Boilers

Htr. No.	Boil'r Cap. in Gals.	No. of B'ler	Dia.	Lgth.	No. Htrs. tap'd for	Cold Inlet	Hot Outl.	Circ.	Std. Test lbs.	Spec. Test lbs.
100	80	1	20″	59″	1	1¼″	1¼″	1½″	200	300
100	100	2	24″	60″	1	1¼″	1¼″	1½″	200	300
100	150	3	24″	78½″	1	1¼″	1¼″	1½″	200	300
200	150	4	24″	78½″	2	1½″	1½″	2″	200	300
200	200	5	24″	103″	2	1½″	1½″	2″	200	300
200	250	6	24″	129″	2	1½″	1½″	2″	200	300
200	300	7	24″	155″	2	1½″	1½″	2″	200	300
300	200	8	24″	103″	2	2″	2″	2″	200	300
300	250	9	24″	129″	2	2″	2″	2″	200	300
300	300	10	24″	155″	2	2″	2″	2″	200	300
400	300	11	24″	155″	2	2½″	2½″	2½″	200	300

Boilers can be equipped with brass or copper steam heating coils and round handhole only. No manholes can be supplied on copper boilers.

Steam Coils for Black Iron, Galvanized Iron and Copper Boilers

Length given in table will raise temperature of water in boiler seventy degrees (70°) in one hour, using steam at five pounds gage pressure.

Size Boiler	Copper		Galv. and Brass	
In Gallons	Diam.	Length	Diam.	Length
80	1″	12 ft.	1″	15 ft.
100	1″	15 ft.	1″	18 ft.
150	1″	20 ft.	1″	25 ft.
200	1¼″	23 ft.	1¼″	25 ft.
250	1¼″	27 ft.	1¼″	30 ft.
300	1¼″	31 ft.	1¼″	35 ft.
365	1¼″	40 ft.	1¼″	45 ft.
425	1½″	40 ft.	1½″	45 ft.
500	1½″	52 ft.	1½″	55 ft.
600	1½″	60 ft.	1½″	63 ft.
800	1½″	80 ft.	1½″	80 ft.
1000	1½″	100 ft.	1½″	100 ft.

Ruud Duplex Multi-Coil Storage Systems

2—No. 200 Heaters with 500 Gallon Boiler
2—No. 300 Heaters with 500 Gallon Boiler
2—No. 300 Heaters with 600 Gallon Boiler
2—No. 400 Heaters with 600 Gallon Boiler
2—No. 300 Heaters with 700 Gallon Boiler
2—No. 400 Heaters with 700 Gallon Boiler
2—No. 300 Heaters with 800 Gallon Boiler
2—No. 400 Heaters with 800 Gallon Boiler
2—No. 500 Heaters with 800 Gallon Boiler
2—No. 400 Heaters with 900 Gallon Boiler
2—No. 500 Heaters with 900 Gallon Boiler
2—No. 400 Heaters with 1000 Gallon Boiler
2—No. 500 Heaters with 1000 Gallon Boiler

Black Iron Boilers are furnished regularly with Duplex Systems. All other boilers are special.

Ruud Thermostatic Moment Valves

Size of Valve	Standard with Heater No.	Boiler Tapping Required	Total L'gth	L'gth Ins. Boiler	L'gth Outs. Boiler	Weight Crated Lbs.	Weight Net Lbs.
1″	100—200	1½″	42½″	30½″	12″	75	29
1½″	300—400	1½″	42½″	30½″	12″	85	33½
2″	500	1½″	42½″	30½″	12″	95	45

NOTE—Moment valves will be adjusted before shipping to any degree ordered. Regular adjustment is 140 degrees F.

Ruud Small Storage Systems

The Ruud Small Storage System is the response to a very general demand for a system having the merit of wide adaptability to all conditions as found in the Ruud Multi-Coil Storage System, but a price in proportion to the smaller requirements it is intended to fulfill.

These small systems have a very wide range of usefulness in many various fields. As has been said in connection with the large systems, the freedom from the limitations imposed by water pressure and gas supply conditions render them almost universally adaptable.

The Ruud Small Storage Systems are built as units, complete ready to set up, and yet, if conditions are such as to warrant a departure from the standard assembly, the systems may be readily changed to suit the conditions of any particular installation by any one skilled in plumbing or pipe fitting.

They are manufactured of the same high grade materials and with the same care as all our heaters and are fully worthy of bearing our trade mark.

The Ruud small Storage Systems operate upon identically the same principle as the Ruud Multi-Coil Storage Systems. They maintain automatically a boiler of hot water at the desired degree for any demand.

As in the large Multi-Coil Storage Systems the system is formed by combining, as a unit, a boiler, Ruud Thermostatic Moment Valve and a Ruud Storage Heater.

Ruud No. 30 Class Storage System

Protected by United States, British, Canadian, German, French and Russian Patents

UNITED STATES PATENTS

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The boilers are made from galvanized iron or copper, as best suited to the character of water to be heated.

Two Series of these systems are offered, being classified by the heating capacity of the heater used in the combination. These Series are:

The **Thirty Series,** consisting of but one combination, a Number 30 heater and 40 gallon boiler. This combination bears the number Thirty-Forty. It is furnished only with vertical boiler.

The **Fifty Series,** consists of three combinations, the Fifty-Fifty, having a number 50 heater and a 50 gallon boiler, the Fifty-Sixty-Six, having a number 50 heater and a 66 gallon boiler, and the Fifty-Eighty, having a number 50 heater and an 80 gallon boiler.

The Numbers Fifty-Fifty and Fifty-Sixty-Six combinations are furnished with boiler vertical or horizontal. Horizontal boiler will be shipped unless ordered with vertical boiler. The boilers are guaranteed for three years for use with water free from acid. They are mounted on a cast iron boiler stand or pipe supports according to the position of the boiler, vertical or horizontal.

The Ruud Thermostatic Moment Valve has been fully described on page 78, and the valve used in these systems is identical in construction, except as to size, as that used in the Multi-Coil Systems.

The heater used in these systems is a development of the Multi-Coil principle with such changes in design as are necessary on account of the smaller size and capacity. It has the same efficiency and is constructed of the same

Rund No. 30 Class Storage System

Heater Door Open and Tank Insulation in Section

high grade of iron and copper as the larger heaters, retaining in its design the meritorious features of removable coils, external manifolds, the elimination of joints in the fire zone and the thoroughly tried and tested Ruud Burners.

The assembly of this system is such as to incorporate in it the advantages of the impossibility of reversed circulation, its cooling effect and heat losses, and, also, the fact that the thermostatic Moment Valve is not affected to the slightest degree by the temperature of the water in the heater, being governed entirely by the water in the boiler.

The insulation applied to these boilers is the best possible for the purpose. It consists of granulated cork completely surrounding the boiler, top, bottom, and side, held in place by an outer jacket of heavy galvanized iron or copper.

To this insulation, as well as the design of the system is due the fact that these systems are the most economical in operation of any small storage system yet devised. The average heat loss by radiation of the complete system, not including pilot, in a recent thorough test, was seven B.T.U. per hour per degree difference in temperature. This remarkable result is due, as we have said, to the following.:

1.—Absolute elimination of reversed circulation.
2.—Covering thoroughly entire tank.
3.—Excellence of covering material.
4.—Position of Moment Valve in tank.
5.—Efficiency of heater design.
6.—Perfect combustion of burners.

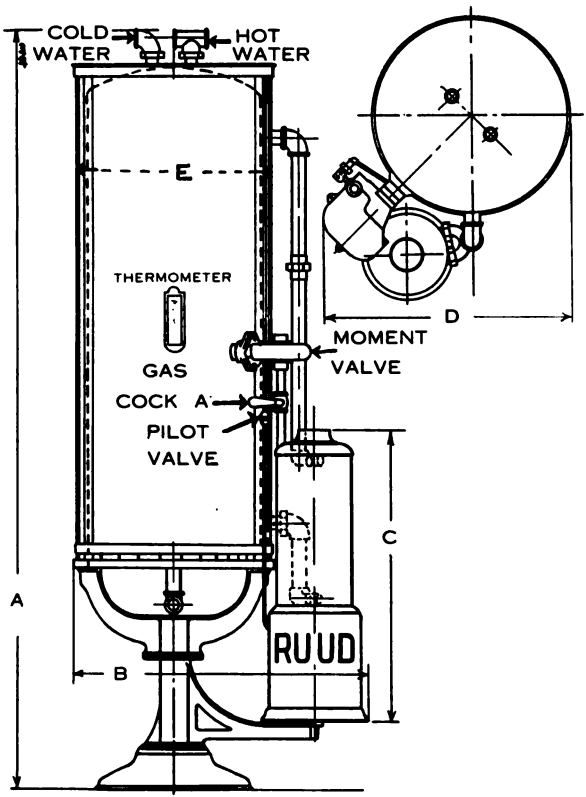
Conditions for Best Service

The remarks on this subject made with respect to the Multi-Coil Storage Systems apply with equal force to the Small Storage Systems. An ample gas supply is readily secured for these systems since the requirements are very small.

Water connections such as are usually run to a boiler may be utilized for these systems.

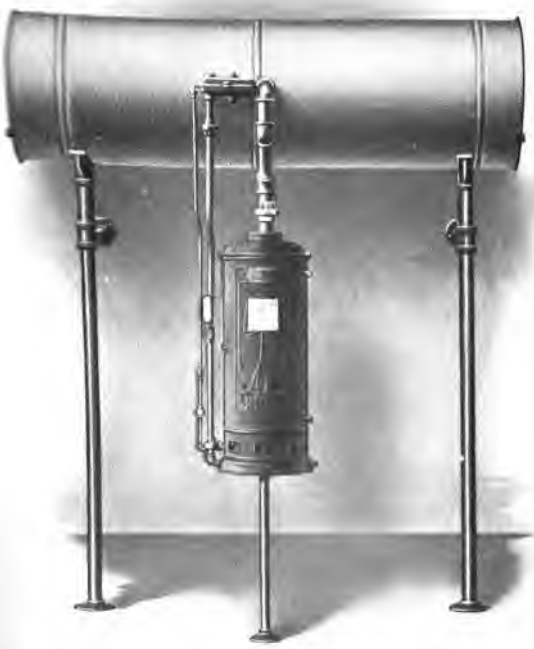
The flue conditions must be carefully looked into as it is quite important that these heaters be connected to a flue with a good draft.

The principle of locating the system nearest to the fixture which will be most frequently used, should be born in mind in determining the proper position to set the system.



Dimensions of Ruud No. 30 System

Size of Heater	Capacity of Tank	A	B	C	D	E	Net Wght.	Crated Weight
No. 30	40 gals.	72″	27½″	27¼″	23″	18″	290	350



Ruud No. 50 Class Storage System

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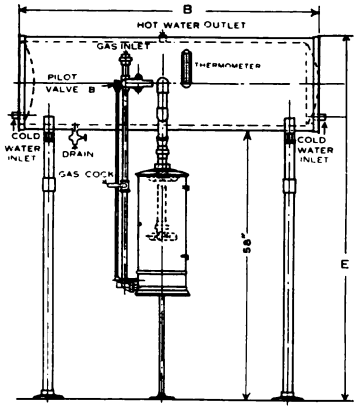
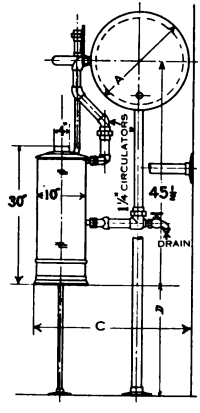
UNITED STATES PATENTS

May 14, 1907 Dec. 31, 1907 Jan. 14. 1913

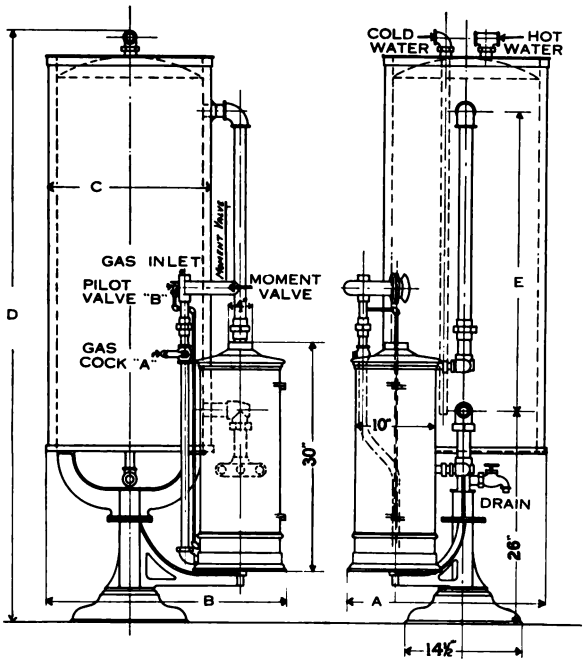




Ruud No. 50 Storage System

TABLE OF CAPACITIES, DIMENSIONS AND WEIGHTS

Size Heater	Capacity of Tank	A	B	C	D	E	Size Flue	Size Circulators	Cold Inlet	Hot Outlet	Gas Supply	Weight Crated
No. 50	50 gal.	19″	63″	32½″	22½″	77″	3″	1¼″	1″	1″	¾″	490 lbs.
No. 50	66 gal.	21″	63″	33½″	21½″	78″	3″	1¼″	1″	1″	¾″	575 lbs.
No. 50	80 gal.	23″	63″	34½″	20½″	79″	3″	1¼″	1″	1″	¾″	645 lbs.



Ruud No. 50 Storage System
Fifty and Sixty-Six gallon Boilers in vertical position

Size	A	B	C	Gas	Hot	Cold	D	E
50-Gal.	24½"	29⅝"	21"	¾"	1"	1"	6' 1¼"	37"
66-Gal.	25½"	31"	23"	¾"	1"	1"	6' 3½"	39"

Ruud Small Storage Systems

To Fit Up Systems

First—For systems with vertical boilers, assemble boiler stand and locate in position. For systems with horizontal boilers, securely fasten boiler supports in place. Set boiler in place on stand or supports.

Second—Set heater on stand and connect its water circulators and gas line to boiler with unions as provided.

Third—Make gas connection to Moment Valve. Always run pipe in accordance with table page 126. Place gas cock in line.

Fourth—Connect vent of heater to chimney. Be sure chimney is clear of all obstructions and has a good draft. Place Ruud draft hood in vertical position in flue connection. Do not insert damper.

To Start System

First—See that the tank and system are full of water and free from air.

Second—See that Gas Cock "A" and Pilot Valve "B" are closed before opening gas valve in gas line to heater.

Third—Open Pilot Valve "B" and light pilot. Regulate to a small flame.

Fourth—Turn Gas Cock "A" full open.

Fifth—Regulate gas flow to proper rate at gas cock in line.

Operation

After starting the system as described, the heater will operate continuously until the boiler is filled with hot water up to the temperature at which thermostat is adjusted, usually 140 degrees Fahrenheit, the gas will then be shut off by the Moment Valve. The Moment Valve will remain closed, and the gas full off, until the temperature in the boiler has fallen at least 25 degrees, when the valve will open again, and the heater will operate continuously until the temperature in the boiler is brought up to that at which the valve is adjusted.

Thermostatic Regulation

The temperature of the hot water is controlled by the Thermostatic Moment Valve, and is usually adjusted at the factory to close off at a temperature of 140 degrees Fahrenheit. Should a higher temperature be desired, remove the hood from the thermostat and turn regulating screw "J" a trifle in. For a lower temperature, turn regulating screw "J" a trifle out. Be careful in adjusting the screw, as a trifle of a turn materially changes the temperature.

NOTE—The hood covering the thermostat levers should always be in place.

Size Heater	Size Tank	Gas Connection to Moment Valve	Cold Water Supply Not Less Than	Flue Connection	Size Meter
30	40 gals.	¾″	¾″	3″	10 Lgt.
50	50 gals.	¾″	1″	4″	20 Lgt.
50	66 gals.	¾″	1″	4″	20 Lgt.
50	80 gals.	¾″	1″	4″	20 Lgt.

Ruud Small Storage Systems are furnished in the following combinations:

Size Number.....	30/40	50/50	50/66	50/80
Size Heater.....	30	50	50	50
Capacity of Boiler	40	50	66	80

Note the Following Carefully

Boilers are regularly furnished of galvanized iron or copper, as ordered.

The No. 30/40 System is made with vertical boiler only.

The No. 50/50 and No. 50/66 System are furnished with boilers either horizontal or vertical, as ordered.

The No. 50/80 System is made with horizontal boiler only.

The No. 50 Horizontal Systems only are furnished with steam coils and hand-holes in the boilers when ordered.

The No. 30/40 System not supplied with hand-hole or man-hole in boiler.

Any of the small storage systems are manufactured in special design for use with hard or lime water, when so ordered.

Ruud Small Storage Systems
Their Application to Residences

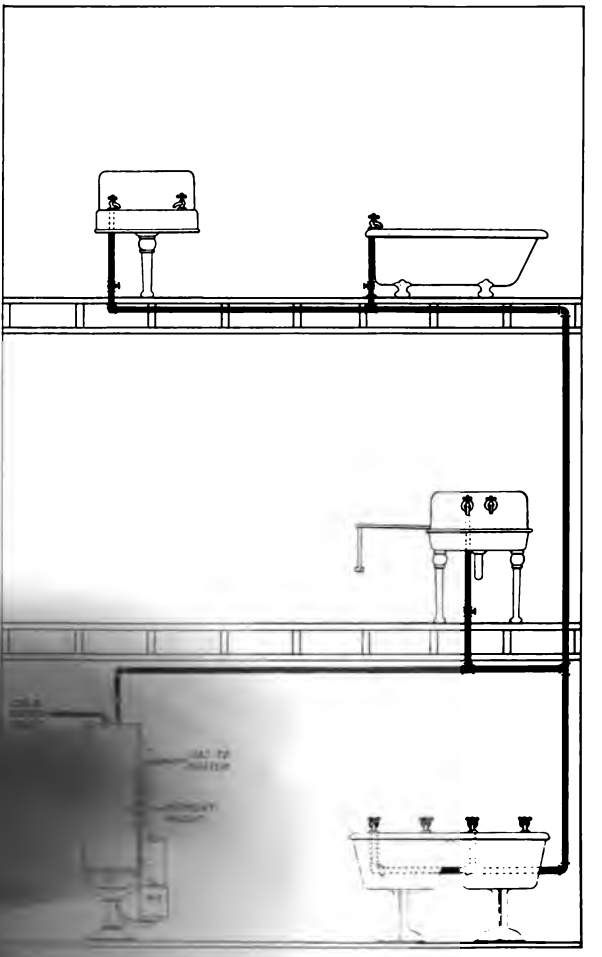
The following is a quick reference table of suggestions of proper sizes of Small Storage Systems for residences. Particular care should, however, be used in each installation to see that no special conditions exist. If they should, the selection of size should be made without reference to this table.

No. 30/40	Residences having one bathroom, and kitchen sink, laundry. Small family.
No. 50/50	Residences having one private bath, servants' bath room, kitchen sink, laundry trays.
No. 50/66	Residences having two private bath rooms, servants' bath, one or two bedroom lavatories, kitchen sink and laundry trays.
No. 50/80	Residences having three or four private baths, servants' bath room, two or three bedroom lavatories and first floor lavatories, kitchen and pantry sinks, large laundry. Comparatively small family.

Ruud Small Storage Systems

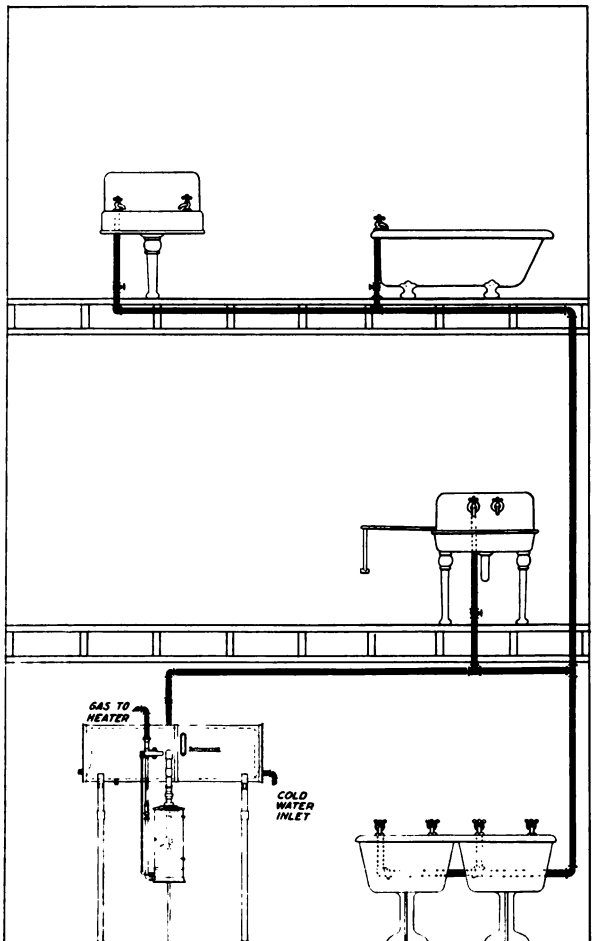
Installation

In view of the similarity in design of these Small Storage Systems to the Multi-Coil Storage Systems, and of both systems to the most ordinary methods of heating water commonly used, it is, we believe, entirely safe to assume that those who are interested in the subject to the extent of reading this book are so familiar with the usual methods of installation as to render any extended instruction in that respect, on our part, unnecessary.

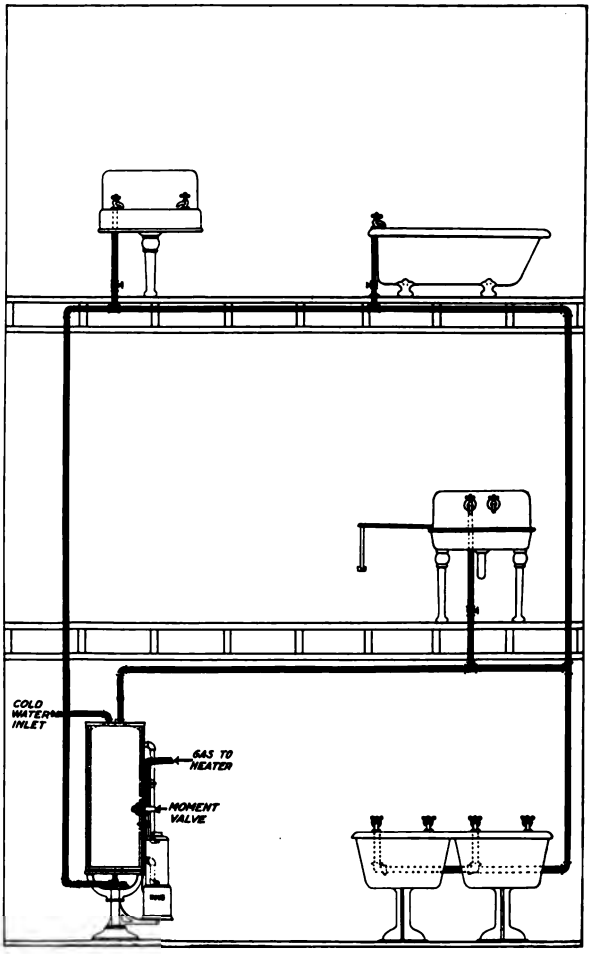


Ruud No. 30 Storage System

Installed on Direct System of Plumbing, supplying Hot Water all over the house

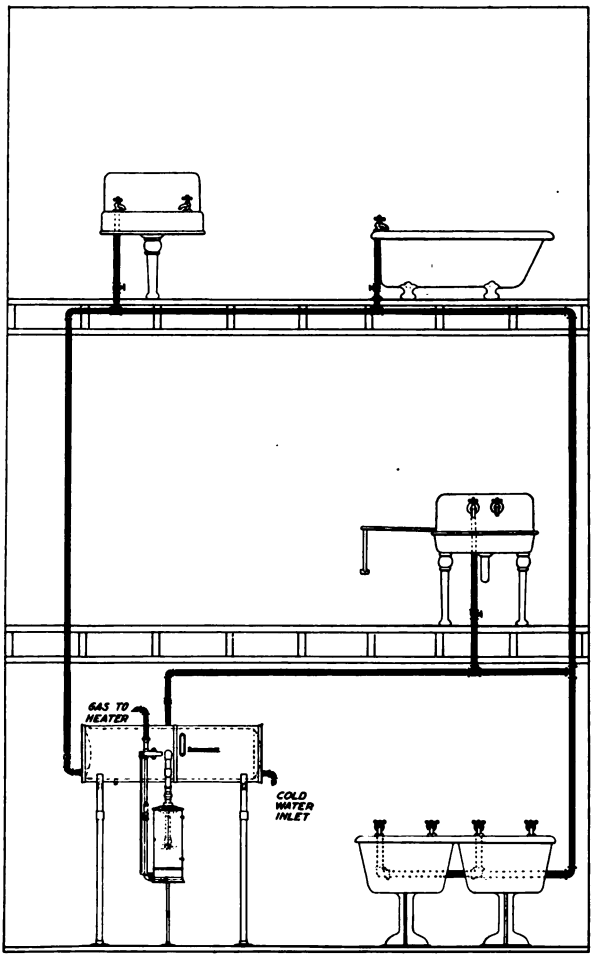


Ruud No. 50 Storage System
Installed on Direct System of Plumbing, supplying Hot Water all over the house



Ruud No. 30 Storage System

Installed on **Return Circulation System of Plumbing**



Ruud No. 50 Storage System
Installed on Return Circulation System of Plumbing

Other Forms of Installation

No. 30 and No. 50 Class Storage Systems

Illustrations of Model Installations for this class are limited to two styles, Direct Supply and Return Circulation, but it should be understood that the No. 30 and 50 Class Systems are adapted to all methods shown in connection with the Instantaneous Automatic as well as the Multi-Coil Storage System. In view of the illustrations covering the latter two systems, we believe it is unnecessary to illustrate in detail the application of these methods in connection with the No. 30 and No. 50 Class Storage Systems, but for convenience we tabulate the common forms not illustrated.

Installed in connection with water supply under pressure from pneumatic tank.

Installed in connection with water supply from gravity tank located in attic.

Installed in connection with water supplied from range boiler.

Installed in connection with furnace coil placed in house heating plant.

Installed in connection with gas supplied from gasoline gas generator.

Having no water valve mechanism, these heaters lend themselves to successful use where gas and water supplies may be unfavorable, and therefore could be said to be very universal in their adaptation to all conditions of plumbing, limited only to the advice that is given under the subjects of "Selection of Size" and "Selection of Type."

Ruud Tank Water Heaters

The advent of the Ruud Tank Water Heater, some years ago, was the result of an effort to place upon the market a tank heater of quality equal to that of our automatic heaters. This effort was successful and the increasing sales of these little heaters attest the appreciation by the trade of their quality of design and material.

Not in even the slightest detail does the material entering their construction or the care used in their making differ from those used in the manufacture of the most expensive Ruud Automatic Heater. The scientific design of the heating surfaces and burner construction, found in these heaters, has placed them upon a very high level of achievement. The difference between these heaters and our automatic heaters is only in the absence of automatic features, never for a moment, in the quality of the heater.

The Ruud Tank Heater is made in three sizes, the Number Twenty, the Number Twenty-Five and the Number Thirty-Five.

The construction of the heater presents many advantages and is a distinct advance over the usual type of tank heater.

The shell of the heater consists of but four parts one of which is a door which swings open leaving the entire interior of the heater, the coils and burner instantly accessible. Within the shell is contained a series of copper coils so placed and graded as to absorb the greatest possible amount of heat from the gases and flames. A ring burner is mounted upon a mixing tube which projects upward through the base of the heater, locking in position but quickly removable for cleaning.

Ruud Double Coil Tank Heater

Ruud Triple Coil Tank Heater

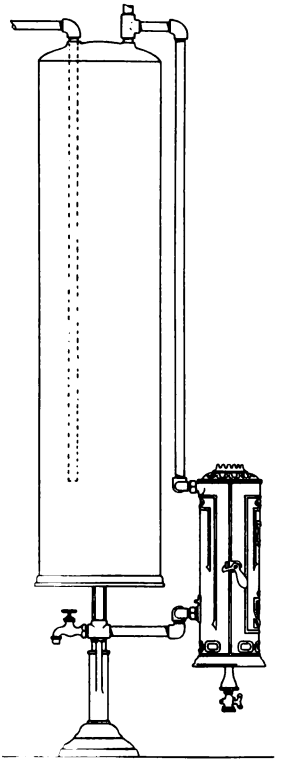
The tubing used in the coils is, like the tubing used in our Automatic Heaters, tested to 1000 pounds per square inch before being coiled and after assembly to 300 pounds per square inch.

The coil arrangement is that of our Multi-Coil development. Individual Coils are joined top and bottom to manifolds, placed outside the heater and not subjected to the processes of combustion. The winding of the coils is in spirals of a different pitch for each coil, resulting in a very effective baffling of the rising gases. This arrangement results in what is undoubtedly the highest efficiency ever attained in a practical tank heater.

The burner is of cast iron and consists of a mixer tube with adjustable air shutter, and the burner proper which is a ring with a flat upper surface, on which are cast radial ridges. In the tops of these ridges are drilled the gas orifices in perfect alignment. The arrangement of the orifices on ridges and at perfectly proportioned distances on a ring burner secures a perfect combustion, evidenced by the even quality of flame, equal in color and size from every orifice, and the utter absence of the flare and unevenness frequently seen in the usual burner.

The design of the Ruud Tank Heater is pre-eminent in the manner in which ease of connection, adaptability to any manner of installation and quick inspection or removal of any part has been promoted.

It will be noted from the illustration that the exterior manifolds, to which the coils are joined, carry the entire weight of the heater. This is accomplished by an ingenious device on the union sleeve, which at the same time holds the shell rigid, carries the weight of the heater and protects the coils from chafing or other injury from external causes.



Ruud Tank Heater Installed

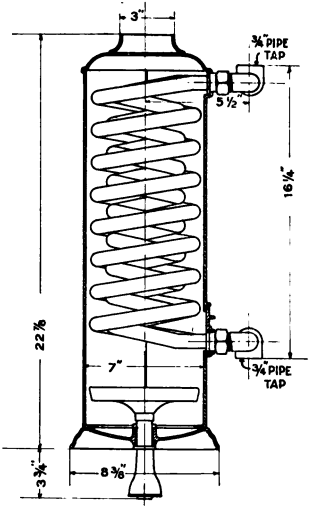
Illustrating the standard method of connecting

Note absence of unions in piping. Unions on heater manifolds serve the purpose, giving economy in installation and maintenance.

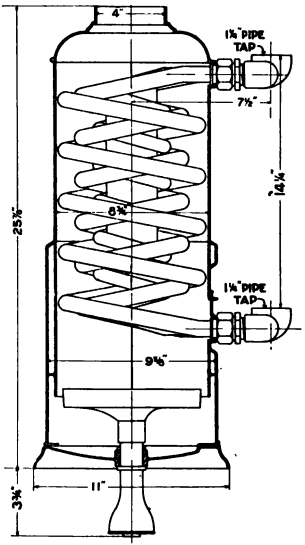
It will also be noted that these manifolds are reversible and interchangeable and are centered upon a vertical axis so that the heater after installation, may be moved to position if not just right when first connected. The time saved in connecting the heater by the lack of necessity of having to cut pipes to a very fine measurement is of material importance.

The method of joining the coils to external manifolds by unions eliminates the need of unions, other than those of the heater, in connecting to the piping.

To this same feature is due the absolute freedom from troubles arising from the use of brazed joints. It is impossible in this heater to find a coil stopped by a deposit of spelter or weakened by burning during brazing. Furthermore, either or both coils being removable, any repairs when necessary may be made at once and on the customers premises and without the necessity of destroying both coils to find the trouble.



Nos. 20 and 25

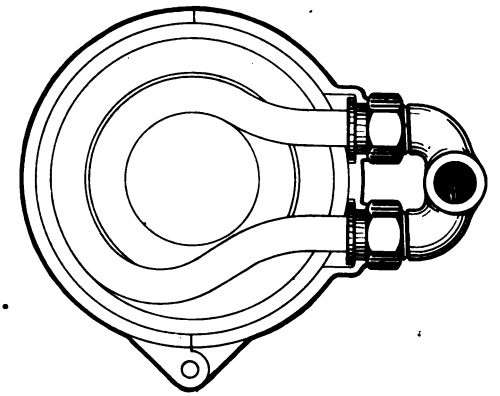


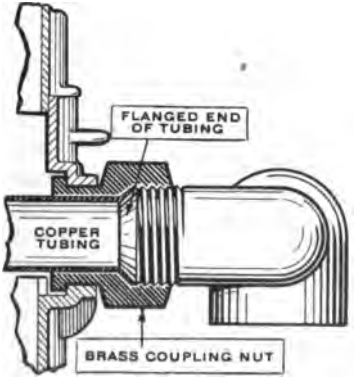
No. 35

Table of Dimensions, Weights, Etc.

Size of Heater	For Size Boiler	Diameter of Coil	Height	Dia.	Net Weight	Weight Crated
No. 20	24-30	$\frac{3}{4}$"	22$\frac{7}{8}$"	7"	33 lbs.	43 lbs.
No. 25	30-40	$\frac{3}{4}$"	22$\frac{7}{8}$"	7"	35 lbs.	45 lbs.
No. 35	40-60	$\frac{3}{4}$"-$\frac{7}{8}$"	25$\frac{7}{8}$"	9$\frac{5}{8}$"	71 lbs.	95 lbs.

NOTE—The No. 35 is equipped with Triple Coil.





Illustrating the Ruud Patented Combined Coil Joint and Detachable Reversible Union

Note how flange of nut automatically locks coil to heater shell

Selection of Type

Ruud Instantaneous Automatic Water Heaters
Ruud Cottage Instantaneous Automatic Water Heaters
Ruud Multi-Coil Automatic Storage Systems
Ruud Small Storage Systems

The correct specification of type and size of heater for an installation can be made only by a careful analysis of the requirements demanded in any particular situation. The importance of a correct specification cannot be too highly emphasized, since the installation of a heater under unfavorable conditions may lead to results unpleasant for all concerned.

Fortunately the rules governing a choice between an automatic storage system, or an instantaneous automatic heater are very few and simple, and fortunately also, there is a wide borderland between the field of the storage type and that of instantaneous type wherein are located most of the everyday installations. It may be said, then, that in most installations the wrong selection would result, not necessarily in poor service from the heater selected, but rather that better service would be obtained if the correct selection were made.

It will be noted from data given elsewhere in the book that the efficiency of the Instantaneous Heater is somewhat higher than that of the storage heater. This is due to the natural physical laws attendant upon the two methods of heating water, and not to any deficiency in design of the apparatus. It follows as a natural conclusion that the Instantaneous Automatic Heater is the proper one to use wherever conditions are favorable to its installation.

The conditions under which an Instantaneous Automatic Water Heater will operate to its best advantage consist of:

First **Good Water Pressure**—The pressure required for Standard and Cottage Heaters is twenty pounds per square inch at the highest faucet to be supplied with hot water. Pressure as low as five pounds can be used if a low pressure heater is ordered. It should be noted here that the No. 4 is the smallest heater made in the low pressure type. Careful reference to the table on page 196 should be made before selecting the size of heater for a low pressure installation.

Second **An Ample Gas Supply**—The service pipe supplying the heater line should be as large, larger, if possible, as the heater supply line as called for in the Fitter's Table for the size of the heater selected. The meter should also be as large a size as specified in the table. The heater must get gas enough to heat the water.

Third **Compact Grouping of Fixtures**—The quicker the water in the piping between the heater and faucet can be emptied of cold water, the prompter the service rendered by the heater will be. Hence, to obtain the best service from the heater the runs should be comparatively short. Frequently, the fixtures will be so located that they naturally fall into two or three separate groups, in which, though the groups be far apart, the fixtures in the several groups will be found in compact arrangement. In cases like this the installation of a heater for each group will be found to work out satisfactorily.

Fourth **Standard Sizes of Piping**—Piping that is too large is just as bad for the service of a heater as piping having too long runs, the amount of water to be discharged from the faucet before hot water is delivered being excessive.

Fifth **An Even Demand**—An even demand can be described as one where at no time, or but seldom, will more faucets be drawing at the same time than can be supplied by the proper size of Instantaneous Automatic Heater.

Sixth **Fixtures of Ordinary Demand**—In this class we would include nearly all fixtures usually met in residences. In some houses and institutions, however, are found faucets of large flow, shower baths of great diameter, needle baths, etc., that will not operate satisfactorily with the flow delivered by even the largest Instantaneous Automatic Heater. Another class of fixtures which could not be well supplied by this type of heater are those where the hot and cold water are mixed before issuing at the faucet to a certain temperature and no variation of this temperature can be allowed. Good examples of these fixtures are Medical Baths.

Seventh **Reasonable Requirements**—If, after being judiciously selected as to size, a heater is installed, it may with reasonable certainty be expected to do its work well, and that the flow from it will be sufficient to supply reasonable demands. Occasionally a condition is met that cannot be fulfilled by any instantaneous Automatic Heater. To cite such a case from actual experience: With a family of three people in a residence with two bathrooms, pantry sink, kitchen sink, and three part laundry tray, a heater which supplied four faucets simultaneously was recently declared unsatisfactory because it would not supply every hot water faucet in the house at the same time with a flow equal to that of the cold water. While this was an extreme case, it illustrates very forcibly, that, perhaps, the most important factor in the selection of the Instantaneous Automatic Heater is that the demand, reasonable or otherwise, will be such that the heater can do what is required of it.

These seven conditions for securing the best results from the Instantaneous Automatic Water Heater should be carefully studied. Fortunately, when they are re-read, formidable as they appear at the first glance, they are simply those usual conditions which prevail in the great majority of homes and other buildings which are prospective users of water heaters.

To repeat, then, an Instantaneous Automatic Water Heater, to render the best service, should be installed only in those homes or buildings where there are:

First—Good Water pressure

Second—Good Gas Supply.

Third—Compact Grouping of Fixtures.

Fourth—Standard Sizes of Piping.

Fifth—Even demand for hot water.

Sixth—Ordinary Fixtures.

Seventh—Reasonable requirements.

A prospective installation should be considered carefully with respect to the above conditions, and if one of the conditions as set forth is lacking, the choice should be an Automatic Storage System.

Naturally, from what has been said before, the conditions suitable for the best service from an Automatic Storage System can be readily deducted. But lest the wrong deduction be drawn that whatever is bad for an Instantaneous Automatic is good for an Automatic Storage System, a few conditions under which the Automatic Storage System is pre-eminently the better, are outlined.

First **Low Water Pressure**—There being no water valve to be operated or long coils to be encountered on a Storage System not an ounce is deducted from the water pressure by its operation.

Second **Small Supply of Gas**—The Storage Systems, owing to the fact that they heat the water at a less rapid rate and store it in a boiler to supply the demand, instead of heating the water as it flows, as do the Instantaneous Automatic Heaters, consume gas at a very much lower per minute rate than the Instantaneous Automatic Heaters. They may be supplied, therefore, with a much smaller service and meter. This factor is very important in considering an installation to be supplied with gasoline gas.

Third **Long Runs or Large Pipes**—From the fact that the Storage System will operate better under these conditions, which are described elsewhere, it must not be inferred that these conditions are a benefit to the installation. Quite the reverse is true. Promptness of delivery, secured by short runs and small piping, is a benefit to any system of hot water generation. It is nevertheless true that the Storage will operate better under these conditions than the Instantaneous Automatic Heaters. These conditions are sometimes unavoidable, since in many residences and institutions the piping must be large enough to supply many faucets simultaneously. The Storage System meets these conditions better than the Instantaneous Automatic.

The time of delivery of hot water at the faucet must be governed by one of two conditions: The rate of discharge at the faucet of the cold water in the pipes, or the rate of inflow into the pipes permitted by the heater. If a faucet be opened capable of discharging water at a rate below the rated capacity of an Instantaneous Automatic Heater, there would be little choice between the Instantaneous Automatic Heater and the Storage System, because either could fill the pipe only just as fast as the faucet could empty it. Even then, however, the Storage would have the

advantage of the few seconds required by the Instantaneous Automatic Heater to heat the initial water drawn from it.

If, on the other hand, the water pressure be heavy or several faucets be opened at the same time, the conditions might be reversed and the rate of discharge of the cold water in the piping would be, in the case of the Instantaneous Automatic Heater, limited by the rated capacity of the heater, while in the Automatic Storage System, the rate would be limited only by the discharge capacity of the faucets, resulting in a much quicker delivery of hot water.

The radiation loss in the pipes would also be lessened by the speed of flow.

Fourth **Heavy or Variable Demand**—This condition exists in any installation where the number of fixtures to be supplied simultaneously will discharge a total flow per minute greater than the capacity per minute of an Instantaneous Automatic Heater, and where the arrangement of the fixtures is such that no satisfactory grouping, as already explained, is practicable.

Fifth **Unvarying Flow or Pressure Required**—For fixtures or installations where no variation of the water flow or pressure can be permitted, such as might occur from an Instantaneous Automatic Heater should too many faucets be opened at the same time, an Automatic Storage System should be specified, because it has no effect whatever on the flow or pressure of the hot water supplied.

Sixth **Excessive Service Requirements**—In cases where the service demanded with respect to flow and pressure is beyond that which might naturally be expected from the number of faucets and general character of installation, an Automatic Storage System should be preferred unless it is very certain that the demand can be supplied by an Instantaneous Automatic Heater.

Selection of Size

Ruud Instantaneous Automatic Water Heater
Ruud Cottage Water Heater

Under suitable conditions of arrangement of fixtures, size of piping and water pressure, the selection of the proper size of Instantaneous Automatic Heater is an easy matter.

It might be well here to call attention to the important subject of rated capacities. Every heater has a rated capacity, which is arrived at by a simple calculation of flow and temperature raise. As an example, a No. 4 Ruud Instantaneous Heater has a rated capacity of 63 degrees raise in temperature of 4 gallons per minute on artificial gas having a heat value of 650 B. T. U. per cubic foot. If the desired temperature raise be greater, the rated capacity will be less. The calculation is: Multiply the number of the heater by 63 for artificial gas, as described above, for natural gas by 80, and divide the product by the raise in temperature required. The quotient will be the rated capacity of the heater expressed in gallons per minute at the temperature raise desired.

If the number of gallons per minute required, and the temperature desired be known, the proper heater to supply the required rated capacity may be quickly determined by the following calculation: Multiply the temperature raise wanted by the gallons per minute wanted and divide the product by 63 for artificial gas of 650 B. T. U. value, by 80 for natural gas, and the quotient will be the number of the heater which will supply the demand. This result will seldom be the exact number of the heater. If it should not be, select the size of heater whose number is larger than the result. Thus, if the result of the calculation is 7.1, select the No. 8 Heater.

For ready reference the capacities of the various heaters have been set down in a table. This table on page 195 enables a quick selection of size of heater to be made or gives the rated capacity of any heater at any raise of temperature.

It will be apparent at once that the specification of the right size heater is largely a simple problem in mathematics. On page 197 is given a table showing the gallons per minute which various fixtures require for good service. By adding the number of gallons per minute of the fixtures that may be expected to be supplied simultaneously, the total flow per minute will be secured, the temperature raise is quickly derived by subtracting the temperature of the cold water from that required for the hot water. With these two factors known the proper size heater may be quickly determined from the tables on page 195, or by the calculation given above.

Ruud Multi-Coil Storage Systems
Ruud Small Storage Systems

To specify the correct installation of Storage System involves somewhat more consideration than to determine the proper size of Instantaneous Automatic Water Heater. The basic principles are the same in both cases, to a large degree.

A study of rated capacities is no less important in connection with storage Systems than in the case of the Instantaneous. The calculations are the same except that rated capacities are figured per hour instead of per minute, and the tables on page 195 are also on the per hour basis. It should be noted here that the rated capacities apply to the heaters only and not to the storage tanks. By suitable combinations of the heaters and tanks it is quite possible to deliver in an hour a far greater capacity than the rated capacity of the heater alone.

The method of determining the proper size system for a given installation follows the same lines as those laid down for the Instantaneous Automatic Heater, except that a new factor, the number of times the fixtures are to be used per hour, is encountered. In other words, with the Instantaneous Automatic Heater the only factor necessary to know is the rated capacity per minute. If the heater will deliver the required flow for one minute, it will deliver it for a week, if necessary. But in the case of the Storage System, the flow per minute is not the essential factor, it is the amount per hour which must be known.

In most installations calling for this type of heater, there are one or two hours of the day when the demand for hot water is heaviest. It is, therefore, customary to provide a system sufficient to fill the demand of the heaviest hour, for if it will do that it may be safely assumed that it will take care of the other hours easily.

In providing for this heaviest hour, the systems' total potential capacity may be utilized. This is computed by adding the heater's rated capacity to the storage capacity of the tank.

The first step in the method then, is to ascertain the flow per minute of each fixture to be supplied, this may be approximated by the use of the table on page 197. When this is done the next step is to estimate the number of times each fixture is to be used in the heaviest hour. This unfortunately is not usually a subject of calculation, so it must be estimated, taking into consideration the number of persons which would be expected to use each fixture.

This having been done, an estimate must be made of the total water used per hour. This is easily made by multiplying the flow per minute of each fixture by the number of times it will be used per hour and multiplying the result by the number of minutes it will be estimated to be in use each time.

As an example: An apartment house containing twelve apartments, each apartment having lavatory, tub, sink and laundry trays. The lavatory calls for three gallons per minute, the tub four gallons, the sink three gallons and the trays four gallons each, using average figures. In any hour it may be assumed that the lavatory may be used four times, the tub once and the sink twice.

This estimate is arrived at by the following reasoning:

Suppose the family consists of husband, wife and two children. Each, upon arising, will naturally make his or her toilet calling for the use of the bathroom lavatory; the husband will probably shave and one of the family will bathe. If the daily bath is taken by all, the chances are that only the husband will take his in the morning as he wants to go quickly to business, the rest of the family will bathe at other hours, since there will not be time for all to bathe before breakfast. Besides, the wife will probably dress hastily and go to the kitchen to prepare breakfast, while the youngsters will not get up until there is just time to dress and wash before breakfast.

In preparing breakfast the sink will be used for hot water perhaps once and in washing dishes after breakfast once again.

This will account for the uses of the fixtures estimated. Now must be estimated the time during which the fixtures will be open.

The morning toilet will probably take one minute each time the faucet is used. A bath takes from ten to twenty gallons of hot water, which would mean an average of fifteen gallons or roughly four minutes for the tub faucet. The dishwashing may use three pans of hot water or, say two minutes use of the faucet, the hot water used before breakfast will amount to little, perhaps a half minute's use of the faucet.

We may list the fixtures then, as below:

Fixture	Gallons per Minute		Times Used		Minutes per Use		Total Gallons
Lavatory	3	x	4	x	1	=	12
Tub	4	x	1	x	4	=	16
Sink	3	x	1	x	½	=	1½
Sink	3	x	1	x	2	=	6
		Total	hour's		demand		35½

If each apartment of the twelve in the building were to draw a like amount the total demand would be 12 x 35½ gallons or 426 gallons. This would unquestionably be the heaviest hourly demand that would arise in that apartment house.

A system therefore whose potential capacity is greater than this would serve the purpose. Such a system would be a No. 200–250, a No. 200 Ruud Storage Heater and a boiler of 250 gallons capacity. This system would start with 250 gallons on hand, and the heater would add 200 gallons more during the hour. During the next hour there would be another 200 gallons available. It would hardly be conceivable in this particular case that the demand of the first hour would be repeated in the hour. But if it were, the specification would be a system of double the capacity, a No. 400–500, that is, a system consisting of a No. 400 heater and a 500 gallon boiler.

The above example is cited to illustrate in an elementary way the use of the proper analytical method of determining the proper size storage system. In many cases such as institutions, factories, industrial installations, etc., the conditions are much more complicated. The analysis of any problem along the lines suggested below, which are simply an elaboration of the above method, will invariably

result in the proper specification, providing ordinary care is used in obtaining data upon which to base the estimates required.

First—Ascertain flow per minute of each faucet or fixture.

Second—Estimate how many times per hour each fixture will be used during the period of greatest demand for hot water.

Third—Estimate how many minutes each fixture will be used each time.

Fourth—Multiply the flow per minute of each fixture by the total minutes the fixture will be in use and add the products. The sum will be the hourly demand.

Fifth—Estimate the number of hours the heaviest demand continues.

Sixth—Estimate at what intervals the heavy demand periods occur.

Seventh—Estimate the hourly demand during the intervals between the heaviest demands.

Eighth—Specify a system whose potential rated capacity is sufficient for the period of heaviest demand and whose rated heater capacity is sufficient for the lightest demand periods and to heat, during the interval between periods of heaviest demand, the storage capacity of the boiler.

Maintenance and Repair Service

The subject of the proper care and maintenance of automatic water heaters is no less important than that of their installation. Any heater, if its original efficiency is to be maintained and the excellence of its service to the user to continue, must be given the care to which it is entitled. That this attention is, in many cases, not given is, undoubtedly, a just tribute to the excellence of the heaters, since many people, users as well as dealers, assume that a heater once installed will continue to operate perfectly until natural wear and tear terminate the life of the apparatus, an assumption not thought of for a moment in the case of any other mechanical device used in modern households. But this high esteem, while appreciated by us, must be deprecated since it is not entirely deserved. The Ruud Water Heater must have a certain amount of attention in order to maintain the service that is to be expected from it. That this attention is less than that bestowed upon the other devices in the house renders it not a bit less important.

Every heater should be periodically inspected. The periods between inspections may be long or short as experience and local conditions will determine.

The inspection of the various parts of the heater, the conditions which may be looked for in those parts and their proper treatment should be taken up in the following order:

BURNERS The condition of the burners should be first looked into, since the principal causes of loss of efficiency in the heater come from burner trouble. Open a hot water faucet, the most convenient one, in order to cause the heater to light up. While it is burning, open the doors of the heater and note whether the burners are all giving the perfect flame they should. The

perfect flame consists of a green cone or series of cones extending about one inch upward from the flame orifices of the burners, a blue flame surrounding this green cone which extends to about half way between the burner top and the lower coil. From this point up the flame takes on a pink or orange tint, which mingles with the blue. Any yellow or white which persists steadily in the flames is evidence of dirty burners. The yellow flames will deposit carbon or lamp black on the coils and reduce the efficiency of the heating surfaces.

Should a yellow flame be noticed turn down the gas at Gas Cock A until the flames from each burner are plainly seen and note which burner or burners is giving the yellow flame. When this is determined shut off the gas at Gas Cock A and remove the dirty burners from the heater. If they are at the back of the burner ring, it will be necessary to remove the front burners first to get at the back ones.

The removal of the burners is a very simple operation. Each burner rests upon a tapered brass spud which is threaded into the burner ring. A set screw in the base of the burner is slightly set up at the factory before shipping to prevent the burner from falling off the spud in shipment. This set screw should be loosened, and the burner may be then lifted off the spud very easily. Sometimes, when a heater has been in service a long time, it may be necessary to tap the burner slightly to start it from the spud.

The burner removed from the heater should be taken apart. This is done by loosening the bolts at each side of the cap, or if necessary driving them out of their slots. The burner will then separate into three parts, the cap, the mixer and the gauze or flame check. Each of these parts should be thoroughly cleaned and the burner assembled and replaced in the heater on the spud.

The mixer and cap may be cleaned by scraping, brushing and tapping, and the gauze may in many cases also

be cleaned by a similar method. But where the gauze is very dirty and has a hard deposit upon it, the best way to clean it is to heat it to a cherry red over a bunsen flame or hard coal fire and drop it, while still red hot, into cold water. The sudden contraction resulting will loosen the hard deposit which may then be brushed off very easily.

If all the burners are dirty they should, of course, all be removed, cleaned and replaced, and the opportunity thus created while the burners are all removed should be improved to remove the burner ring, scrape the base of the heater clean, scrape clean the burner ring and repaint the base of the heater inside and out, the burner ring and each burner with black asphaltum varnish. Indeed, it is a very good plan to repaint the entire outside of the shell and the inside of the burner chamber at such a time. It is an opportunity that happens but seldom and the repainting adds materially to the life of the heater as well as to its appearance.

The latter is important if the maintenance or repair is paid for by the user. It takes but little more time but makes a finished job, the charge for which will be paid by the customer willingly because the results of the work are plainly apparent.

The flames from the cleaned burners should, when the burners are burning at full flow, extend to the second coil section or about to the level of the gas inlet of Valve A. If they go higher than this they are getting too much gas, if less than this, too little gas. Should either be the case, it may be detected by opening several hot water faucets and Valve C of the heater wide open, so that there will be no cutting down of the gas flow by the thermostat, and adjusting the flow of the gas to the proper rate at the stop cock on the gas line, not at Valve A, because it may be tampered with. This adjustment is made by timing the gas meter's test dial and adjusting the stop cock until just the proper

amount of gas per minute is flowing. The adjustment once made should be rendered comparatively permanent by screwing up the nut on the stop-cock. Of course, if the gas pressure varies greatly this adjustment is worthless and a governor or gas pressure regulator should be installed.

PILOT BURNER This should be examined to see that the orifices are clear; if they have become clogged a stiff wire inserted will in most cases clear them. The carbon deposits at the orifices, if they exist, should be brushed off and the position of the pilot burner noted to be sure that the flame orifices are just above the flame orifices of the main burners.

The flame should be adjusted, generally, to a point where the tips of the flames just curl over the edge of the mushroom-like top.

WATER VALVE At every inspection the action of the water valve should be carefully examined. In the course of inspecting the burners ample opportunity is given to see that the action of the water valve is right. The most convenient hot water faucet should be opened and closed several times, and at the same time, it should be noted whether the gas in the heater is turned on and off promptly each time.

If the valve should act sluggishly it may be clogged by sediment or other foreign matter. In such cases the cap should be removed, the plunger taken out of the valve, and the inside of the cylinder and outside of the plunger wiped with crocus cloth held taut on a flat piece of wood. If, after the valve is reassembled the action is still sluggish, the speed regulator should be screwed out a turn or two. This should cure the trouble, especially as regards the opening of the valve. If the valve persists in closing slowly it may be safely assumed that the trouble is due to air in the hot water piping. Every faucet in the building should now be opened until any air is allowed to escape, after which there

should be no trouble with the valve. Should the trouble continue the hot water lines must be thoroughly traced and the air traps found and emptied. Fortunately this is not apt to occur as a maintenance trouble, since it would be apparent and cured at the installation of the heater.

The valve should be looked over carefully to see that no leaks are present at the cap or the stuffing box. If there are leaks they should be remedied by tightening the caps. Care must be exercised regarding tightening the stuffing box cap, that it be not drawn so tight that the packing binds the valve stem. The stuffing box cap should be tightened by hand only, a wrench or pliers should never be used upon it. If a leak persists a new packing should be put in.

THERMOSTAT

After testing the water-valve a hot water faucet should be opened to permit a very small stream to flow. It should now be noted whether the thermostat shuts off the gas at intervals. The temperature of the water should be noted to see that it is hot enough. If the thermostat is shutting off correctly, and the temperature satisfactory, no further attention need be given it. Should the water not be hot enough and the thermostat shuts off the gas, the hood which covers the thermostat levers should be removed and the thermostatic adjustment screw "J," a square head bolt with hexagon locknut at the fulcrum or left end of the long or outside lever, should be screwed in a trifle. Not more than a quarter of a turn, or one face of the bolt, should be made at a time. After turning this bolt a quarter of a turn the temperature of the water should be noted before turning it any more. It is best to give the bolt the turn instantly after the thermostat has closed off the gas at the previous adjustment. This will relight the gas at once until it is

closed off at the new adjustment. Each quarter turn of the bolt raises the adjustment about ten degrees. After proper adjustment is secured the locknut should be tightened and care used in doing this to see that in tightening the locknut the regulating screw is not turned. If the water running at the faucet is too hot and the thermostat does not shut off the gas, the thermostat adjustment should be lowered by turning the regulating screw out until the proper temperature is secured.

It is very important to be sure that the thermostat is to blame in the case of the water being too cool or not hot enough before the adjustment of the thermostat is altered. In most cases this trouble will be due to the faulty regulation of the water or gas flow. If the flowing water is not hot enough and the gas burns continuously at the burners the thermostat is not at fault. It should be made sure that the proper amount of water is flowing through the heater at the temperature desired before the thermostat is even thought of in this connection. If the proper amount of water, see table page 195, which the heater should deliver at the temperature desired is flowing, and the water is not hot enough, the gas meter should be timed and the amount of gas flowing should be noted. If this is correct, then, and not before, should attention be given to the thermostat. If the thermostat is shutting off the gas it should be adjusted, but if the gas is burning continuously the thermostat should not be touched. The fault is elsewhere.

In no case should the locknuts on the thermostatic gas valve stem be disturbed.

GAS VALVES These should be examined to see that the caps are tight. The primary or upper gas valve may be tested to see that the seat is tight by removing a burner, opening a faucet and lighting the gas at the burner spud. The faucet should be turned

off at once. A little flame at the spud will remain after the burners go out because of the gas remaining in the burner ring. This flame will burn for two or three minutes and then diminish and go out. During its burning, Valve A should be turned off and as the flame begins to diminish, Valve A should be turned on. If the flame at the spud increases when Valve A is turned on it is proof that the upper gas valve is leaking. A new washer should be put on.

COILS

The coils are the heating surfaces of the heater. It is very essential that they should be clean at all times. The outside condition of the coils may be quickly noted by their appearance. If the coil is covered with carbon or lampblack it should be brushed off with a wire brush until all loose carbon is removed. If the coil is very dirty and carbon caked on it, the coil should be removed from the heater, thoroughly cleaned and replaced.

Fortunately if the burners are kept clean the coil will not get dirty, so that the bad cases are rare and seldom repeated.

Cleaning the inside of the coil tubing is seldom necessary except in the parts of the country supplied with water containing mud, lime or other easily precipitated minerals.

Mud deposits are comparatively easy to clean out. To remove mud from an Instantaneous Automatic Water Heater Gas Valve A should be closed, the water inlet valve of the heater closed, a nearby hot water faucet opened, a block of wood or other small object inserted between the stems of the water and upper gas valves so that the upper gas valve is blocked open and Valve A turned on again. The thermostatic gas valve should now be opened by pulling the stem with pliers, the gas which will at once ignite at the burners, should be allowed to burn until

steam is formed in the coils. The noise and hammering in the coils will tell when steam is formed. After a minute or two the valve stem should be released which will at once close off the gas. The block of wood should be removed from between the stems of the water and upper gas valve and the inlet water valve opened full. The mud will then be washed out at the faucet.

To remove the mud from a Multi-Coil Storage Heater, the gate valve on the cold circulator should be closed and the draw-off valve at the bottom of the manifold opened. This will flush out the mud from the coils at the draw-off valve. After the mud is flushed out the draw-off valve should be closed and the gate valve in the cold circulator opened.

The removal of lime and similar mineral precipitates from the coils is a somewhat slower process. The deposits must be dissolved by a hydrochloric acid solution. The solution used may vary from undiluted acid to a solution of one part of acid to ten parts of water. Undiluted acid is not recommended as it may attack the coil. Probably a solution of one part acid to four parts of water is best for general use.

For the Instantaneous Automatic Heater the process is as follows:

Close the water inlet valve, disconnect the hot water line from the heater outlet and attach a faucet or valve to the heater outlet. Remove the bonnet of Valve C, using a monkey wrench. Open the faucet and as the water drains out of the coil pour in the acid solution at Valve C until acid shows at the faucet; the faucet should then be closed. Allow the solution to stand in the coil for thirty minutes. Then replace bonnet of Valve C and turn on water inlet valve slightly. Open faucet on hot water outlet full, allowing the acid and

impurities to drain off slowly. If they are forced out too fast they may pack and clog the coil. When all impurities have passed out and the water runs clear, open the water inlet valve full and note the water flow. If it is satisfactory connect up the hot water line again, if not, repeat the process. In obstinate cases it is sometimes necessary to apply heat by removing disc from upper gas valve, turning on Valve A and allowing burners to light. Should this be necessary the bonnet of Valve C should be replaced and the water inlet valve opened.

The coils of the Multi-Coil Storage Heaters must be removed from the heater and treated singly. Each coil should be filled with the solution, corked at one end, and allowed to stand for thirty minutes or longer as required.

The stoppage of the coils is detected in the instantaneous Automatic Water Heaters by a poor flow of water otherwise unaccountable for and in the Multi-Coil Storage Heaters by steam-hammering in the coils.

FLUE

The condition of the flue should be noted at each inspection. This can be done quickly and positively by lighting a taper, candle or rolled up paper and holding the flame at the base of the draft-hood. If it is pulled into the draft hood the flue is clear. Another way is to note, while the heater is burning, whether the products of combustion are coming out at the draft-hood or going up the flue. This can be ascertained by simply holding the hand at the base of the draft-hood while the heater is in operation. If a downdraft of warm gases is felt, and persists, the flue is not working well. If cool air is being drawn into the hood the flue is all right.

If the flue shows evidence of not drawing well, the flue connection should be removed and the flue examined to see that no accumulation of soot, dirt or other matter has taken place. In old flues, formerly used by coal apparatus, or in

flue also used by a coal or wood burning appliance the accumulation of dirt, etc., is very common. This dirt should be removed, the flue tested again for draft and if found all right, the flue connection to the heater re-connected.

REVIEW

All parts of the heater will by this time have been tested and remedied, if the order as given has been followed out. But before leaving the customer's house the repairman should interview the head of the household if he or she be at home, or, if not, a responsible servant, and ascertain whether there are any complaints about the hot water service. There are sometimes conditions in the plumbing which will give rise to poor service in the bathrooms or other parts of the house which are not revealed by an inspection of the heater in the basement. If there are any complaints, they should be remedied at once, if possible, and the results shown to the person who made the complaint before the repairman leaves the premises.

The repairman should note as he makes his inspection any parts of the heater that may need replacing, any repairing that may have to be done, or any condition in existing plumbing, etc., that may call for repairs or alteration in the near future, or before or at the next inspection. These notes should be given to the manager by the repairman upon his return from the job.

These notes are useful to the manager in several ways:

First—Where the maintenance service is free or on contract, but repairs charged additional; they enable the manager to make an estimate to the customer.

Second—They enable the manager to write or notify the customer of existing conditions and so forestall complaint should another call be necessary at the customer's house in the near future.

Third—They enable the manager to have in stock against the emergency the necessary repair parts and so avoid interruption of service to the customer.

Fourth—Should faulty work be found, done by a plumber, or furnace man, which interferes with the proper service from the Ruud heater, the manager is enabled by these notes to take up the matter in a tactful way with the business firm whose workmen may have been at fault and have the trouble corrected without calling it to the attention of the customer. This will make a friend for the house instead of an enemy who might have been made by allowing the matter to drift to a point where, to save the Ruud heater's reputation, the faulty work must be shown to the customer.

Fifth—The repair parts being in stock, these notes will enable the manager to see that the repairman on his next visit, if they are not needed until then, takes them with him and does not have to waste time returning to the shop to get them.

General Notes on Maintenance and Repair Service

In regular maintenance service a card index or tickler system should be used. When the service is first established all heaters should be visited at the same intervals but as repeated visits are made it will be noted that some heaters, owing to local conditions, need attention less frequently than others. These heaters can be visited at alternate inspections. By carrying out this system much labor and time spent uselessly may be conserved.

The carrying in stock of gauzes, burner bolts and other commonly needed repairs will be a good investment. If the repairman has in his kit a supply of gauzes and bolts he can replace the dirty gauzes with clean ones, and, instead of cleaning the dirty gauzes on the customer's premises, he can bring them in with him and let them accumulate until he or less skilled labor, can clean them in the shop at odd hours.

Occasionally a man formerly employed in the shop or on outside work is given repair service to attend to. His habits, formed by other work, are apt, unless he is cautioned, to lead him unconsciously to give offense to the customer or the household. The following points should be brought to his attention:

Always conduct yourself quietly both as to talking, walking and working. Act always as if your wife and infant were asleep upstairs. Never scratch matches on walls, floors or furniture, and never leave the burnt matches on the floor or any where except where they belong.

Do not drop your kit, tools, materials or heater parts. Lay them down.

If you have to remove dirty parts of the heater, lay down newspapers first to protect the floor from dirt. Yes, even the cellar floor.

Do not use tobacco in any form while on the customer's premises.

Avoid the use of liquor during working hours. You may think a drink does no harm, especially on a cold day; perhaps it doesn't. But if the slightest thing goes wrong with your work the customer or servants, having smelt liquor on you, will declare you were under its influence. That will not do you or your house any good, or make the matter any easier to adjust.

Avoid conversation which is unnecessary, especially to the members of the household. The slightest word, misunderstood, is frequently used by the customer as an excuse for not paying the charge for your services, and a conversation, perhaps but five minutes long, about any subject but the work in hand, is apt to result in a demand for a deduction from the bill on the ground that you were talking and not working most of the time you were on his premises.

If your hands or overalls are dirty or greasy avoid contact with painted work or walls. A hand print on a clean wall or door jamb is a souvenir of a careless workman.

If your work takes you upstairs always ask a servant whether you may go there and ask if she would like to go with you or notify the household of your coming. This is for your protection. Thieving servants are apt to shield themselves by blaming workmen. Do not let them have a chance to put anything over on you.

Always knock and wait until you get a reply or are sure no one is in before entering a room even if the door is open. Some folks are hard of hearing. A woman member of the household surprised at the entrance of a workman into her room when she is not sufficiently dressed to permit [redacted]ntrance means a customer lost to the firm.

Always enter a house by the rear door and announce your arrival to some member of the household or servant, before going to work on the heater.

When your work is finished clean up the place where you have been working. Leave no trace of your work except a clean looking, properly working heater.

The well-equipped tool-kit for repairing and maintenance service should contain:

1—14" Pipe Wrench
1—10" Pipe Wrench
1—10" Monkey Wrench
1—10" Screw Driver
1—pair Combination Pliers.
1—2" Wire Brush
1—Thermometer—Scale 30–220
1—2" Paint Brush
1—Pint Asphaltum Paint.
1—10" Flat File.
1—Stiff Putty Knife
1—Machine Hammer
Supply of Crocus Cloth
Supply of Burner Gauzes
Supply of Burner Bolts
Supply of Pilot Burners
Supply of Washers
Supply of Packings
Supply of Springs—different weights
Supply of Burners

Water Heater Troubles

The heading is slightly misleading, for a large proportion of complaints received after a water heater is installed may be quickly traced to causes and conditions quite outside the water heater or any influence on the service it could possibly exert. But these troubles, as well as those due to the heater, must be handled or found by the water heater repairman in order that the hot water service may be restored to the normal.

It is not an easy subject to treat acceptably. With a full knowledge of the apparent risk of the admission, but for the sake of the purpose of this book, it is to be said that those who come into contact with complaints are, perhaps, justified in believing that the complaints are endless in their variety. But while complaints do take many various forms, and many peculiar actions of the heater are described to the service man over the telephone, practically all complaints, when analyzed, will be found to belong under one or more of those listed on pages 171-189.

It would be very gratifying if it could be said that all possible complaints were listed. It can, however, be stated that a sincere effort has been made to list all that could be imagined or gathered from experience. The length of the tabulation and frankness of treatment will be evidence, to the indulgent reader, that if any complaints are not included, they have been left out not with the purpose of concealing any shortcomings of the apparatus. In compiling this list an endeavor has been made to state the complaint in such a form that no matter how the complaint is stated by the customer, it can readily be recognized in the book. This method was believed more to be preferred and capable of greater usefulness than that in which the parts of the heater are listed and the troubles which might be looked for with those parts.

High Gas Bills

This subject cannot very well be treated by the method used with the other complaints. The first thing which must be ascertained in running down a high gas bill is to be sure that the Water Heater is to blame for it. This is not always an easy thing to do where a separate meter for the water heater is not used, but comparison with previous gas bills should be made to find out, if possible, the approximate amount of gas consumption for which the heater may be blamed.

Many high gas bills are high, not because of the amount of money involved, but because of the unreasonable attitude of the consumer. Diplomacy must be used in such cases to endeavor to bring the consumer around to the point where he is satisfied that the amount of water he is using, and the service he is getting, justify the amount of the bill.

To attempt to estimate the proper gas bill for a household containing any given number of persons is almost hopeless. It may be said, however, that the gas bill which runs more than one thousand feet of gas per month per member of the household, including servants, may be assumed to be a high bill, unless the conditions surrounding the installation, such as large piping, long runs, excessive use of water, etc., are apparent.

Where the bill is higher than it should be, attempts at correction of the installation, or the method of use of hot water, must be made. Since the kitchen is the place where excessive use or abuse of hot water is most often to be found, the first attempts to reduce the bill should be made there. A self-closing faucet should be installed on the kitchen sink and the flow at the kitchen sink, pantry sink, and laundry tubs should be noted, and if it is in excess of the table as given on page 197 it should be cut down to conform

to that table. This can be done by turning the safe-stops or valves controlling the lines to the various fixtures, and adjusting them to give the proper flow, no matter how far the faucet may be opened. This will probably result in cutting down the use of the water very materially, with a consequent saving in gas. It would be well to extend this operation to include every faucet in the house if the other faucets show excessive flow of hot water.

Another serious source of wastefulness is the habit on the part of many people of turning on the hot water faucet with the idea that they want hot water, using the cold water which first flows from the faucet, and then turning off the faucet before the hot water gets there instead of waiting for the hot water to flow. An explanation of this, with the recommendation that the hot water faucet be not turned on unless the hot water is wanted badly enough to wait until it comes will aid in cutting down the gas bill.

On return circulation systems of plumbing the circulating lines should be covered wherever possible. Careful attention should also be given that the gas flow is adjusted to the proper rate for the heater in service.

An observance of these suggestions should reduce any gas bill to a point where it is within reason, and indeed to the point of economy that is found with the use of the majority of Ruud Heaters installed.

Complaints and Remedies

No. 1. No water or poor flow from all hot water faucets.

A. May be due to poor water pressure suddenly developed by a break in the water main in the street, rearrangement of city water supply or to a large cold water faucet running or to several small leaks in the cold water lines, such as flush tank valve seats worn out and running continuously.

To find out if this is the cause note whether cold water pressure is as good as ever, or use a pressure gauge.

Treatment—Put weaker water and gas springs on the heater, or if these do not cure the trouble put on a larger water valve. If the poor water pressure is temporary only, the matter can be explained to the customer and the heater left out of service until normal conditions are restored. If hot water is needed badly the plunger of the water valve and the disc of the upper gas valve can be removed and the heater permitted to operate temporarily under the thermostatic control.

B. May be due to stoppage in hot water line.

To find out if this is the trouble, disconnect the union on the outlet hot water line at the heater and note whether the flow of hot water there is as good as usual. If it is the stoppage is beyond the heater, and the customer should be advised to send for a plumber to clear the line. If the flow is not good the stoppage may be in the heater. To find this out, disconnect the union on the inlet line to the heater and note the flow. If it is not good, the stoppage is between the cold water line and the heater. Advise the customer to send for a plumber to clear the line. If it is good the stoppage is in the heater.

Treatment—Remove cap from water valve, take out plunger and see that the ports are clear and test the valve

action by hand. If the plunger does not move freely, the inside of the valve and outside of the plunger should be wiped with a piece of crocus cloth held taut on a flat block of wood. If this does not do the trick use a flat file on the plunger at those spots which seem hard or not quite true to the circle. The file should be used very sparingly. The cold water line has been, supposedly, disconnected, but should it have been reconnected, disconnect it and try the valve again. Sometimes the piping is in a strained position, which, when communicated to the valve, distorts the body just enough out of true to bind the plunger.

When the valve works freely, connect up the cold water line again, being sure to take out the strain, if there is any, and reassemble the valve. Next take Valve C apart and clear it of any matter that may have stopped the flow. While Valve C is removed, again test the flow of water. If the flow is good at the body of Valve C, it proves that the gooseneck and water valve are clear. When Valve C is clean, put it together again. It has now been proven that the stoppage is in the coil. After it has been examined to see that the tubing has not been pinched in some way as to stop the flow, the coil should be cleared, using the method described under the heading "Coils" in the chapter on Maintenance on page 160.

C. May be due to cold water inlet valve being closed.

Test and treatment are obvious.

No. 2. No water or poor flow at certain faucet or faucets not on the same line or floor.

A. Must be due to local trouble with the faucets.

To find this out, remove one of the affected faucets and note whether the flow of water is as good as usual. If it is not, the trouble is stoppage in the line, and a plumber

should be brought in to clear the line. If the flow is good examine the faucet carefully and it will be noted that the washer, or fuller ball if it is a fuller bibb, has become swollen and stopped the passage. The washer should be replaced.

No. 3. No water or poor flow at certain faucets, all on the same line, but not on the same floor or floors.

A. Must be due to stoppage in the line.

To find out if this is the cause try the flow at other unaffected faucets. If they flow all right the trouble is in the line and a plumber should be called in by the customer to clear the line.

No. 4. No water or poor flow at certain faucet or faucets, all on the same floor or floors, but not on the same line.

A. Must be due to low water pressure.

To find out if this is the cause, proceed as in Complaint No. 1, Cause B.

Treatment—Complaint No. 1, Cause B.

It is sometimes found that when Valve C is regulated for the water flow obtainable on the lower floors, the decreased pressure on the upper floors is not sufficient to pass the rated capacity through Valve C. In such cases it may be advisable to regulate Valve C for the upper floors and control the flow at the lower faucets by adjusting the stop cocks on their respective branches. Care must be exercised in adopting this plan as it may give rise to a form of complaint No. 7, Cause A. It may be said that this method should be used only where the members of the household and servants have sufficient mechanical understanding to appreciate the situation or where the occupants of the house are so few that the chance of the simultaneous use of faucets is small.

No. 5. Water not hot enough or cold at all hot water faucets.

A. May be due to water entering line at some other point than the heater.

To find out if this is the cause, close the water inlet valve on the heater's supply line and note whether faucets will still flow. If they will, it is proof that water is coming into the hot water line but not through the heater.

Treatment—Be sure that all valves are closed at all mixing points such as the by-pass valve, if it is a reheating system, the shower or needle bath valves on the hot and cold supplies, valves on lines leading from other boilers, should there be any, and also be sure that there is a check valve on the return, if it is a circulation system, and that this check valve seats tightly. Be very sure, even to the extent of taking valves apart to see that they are not defective.

B. May be due to worn out water valve.

To find out if this is the cause, after Cause A has been disposed of, turn on a faucet slightly and note whether water valve stem moves forward. If it does not, increase the flow at the faucet gradually, at the same time noting the effect on the water valve stem. If a fair size stream can be drawn without moving the valve stem the water valve is worn out.

Treatment—Put on new water valve.

No. 6. Water not hot enough, or cold at upper floor faucets or small faucets only.

A. May be due to worn out water valve.

To find out if this is the cause, proceed as in Complaint No. 5, Cause B. The explanation is that the flow per minute is smaller at the upper and smaller faucets and not sufficient to operate the water valve. The larger

and lower faucets have a flow large enough to operate the valve.

Treatment—Complaint No. 5, Cause B.

No. 7. Water not hot enough, or cold, at lower and larger faucets only, except at times at all faucets.

A. May be due to poor adjustment of heater as to gas and water flow.

Explanation is that the smaller and upper faucets have a smaller flow per minute and the water is heated; the larger and lower faucets have such a large flow that it exceeds the rated capacity of the heater and at times, several faucets open at the same time also permit an excessive flow of water.

Treatment—Adjust heater correctly.

No. 8. No water or poor flow at certain hours at all faucets or those on upper floors only.

A. May be due to reduction of water pressure at those hours. This happens more or less frequently in cities with inadequate water supplies.

To find out if this is the cause, question the customer or make observations of the pressure at different hours.

Treatment—Complaint No. 1, Cause B, and equip the heater for the low pressure, with due regard for Complaint No. 9.

No. 9. Water not hot enough at certain hours at all faucets, or only at the lower or larger faucets.

A. Must be due to variation in the City water pressure. Explanation is that the heater is adjusted as to water and gas flow for the low water pressure. When the water pressure increases, the flow exceeds the heater's capacity.

Treatment—Adjust the heater for the high water pressure. If necessary, instruct the customer how to regulate Valve C. Advise installation of pressure regulator on water line.

No. 10. Shower bath changes temperature suddenly.

A. May be due to other faucets on hot water line opening at the same time as shower bath.

Treatment—Reduce the flow of cold water to shower until it equals rated capacity of heater. Install, if possible, mixing chamber on shower bath. These will help but not entirely cure the trouble. Advise customer of conditions. The above refers to Instantaneous Automatic Water Heater. Advise an Automatic Storage Heater if customer still complains. If the trouble occurs with that, the fault is in the piping, and a plumber should be called in to remedy the trouble.

No. 11. Gas lights flicker when heater is turned on.

A. May be due to speed of valve action.

Treatment—Screw in speed regulator on water valve until speed of water valve's opening is reduced or with valves not having speed regulator, put in stronger spring.

No. 12. Gas lights go down and stay down while heater is burning, or gas range burners are extinguished when heater is turned on.

A. May be due to too small a gas meter.

Treatment—Install one of proper capacity.

B. May be due to too small a gas service.

Treatment—Install one of proper size.

C. May be due to a choked gas service.

Treatment—Clear the service.

No. 13. Odor of burnt gas in the cellar.

A. Must be due to flue trouble.

Treatment—Remove flue connection from heater and examine flue. Clear out any dirt or other obstructions and see that the flue is clear to the roof. If necessary use a ball and rope, letting the ball down from the top of the flue. When satisfied that flue is clear, re-connect the flue connection and test draft. If there is still no draft or a down draft, a flue expert should be called in.

No. 14. Odor of burnt gas throughout the house.

A. May be due to flue trouble as in Complaint No. 13, and the odor filters up through the floors, doors, or other opening in to the whole house.

Treatment—Complaint No. 13.

B. May be due to gases entering in a certain room or rooms and thence circulating through the whole house.

Treatment—Complaint No. 15.

No. 15. Odor of burnt gas in a certain room or rooms.

A. May be due to the heater being connected by error into an unused warm air or heat flue.

To find out if this is the cause, burn feathers or rubber or some other substance with an unmistakable odor in the draft hood of the heater and observe whether this smell is quickly noticeable at the registers in the rooms in question. Or, remove a register face on the lowest floor, and lower a weight by a string and observe whether it appears at the flue to which the flue connection of the heater is led.

Treatment—Connect the heater to another flue or, if the flue extends to the roof, remove registers, plaster up the openings and remove cap from top of flue.

B. May be due to heater being connected, through error, into an ashpit of a fire place.

To find out if this is the cause, burn a substance with an unmistakeable odor in the draft hood of heater and observe if the odor is quickly noticeable at the ash trap of the fire place.

Treatment—Reconnect the heater to a good flue.

C. May be due to the flue with which the heater is connected joining a fire-place flue.

To find out if this is the cause, lower a weight on a rope from the top of the flue to which the heater is connected until it reaches the bottom, then secure the rope at the top. Build a fire of papers in the fire place and note whether the smoke and burnt paper come out at the top of the chimney through the same flue that the rope which holds the weight is in.

Treatment—Call in a flue expert.

No. 16. Draft from water heater interferes with draft from furnace, boiler, or other coal burning appliance.

A. May be due to too great a draft through the water heater.

Treatment—Insert a damper in flue connection of water heater. This damper should have holes cast in it or be cut so as to prevent its being absolutely tight. The damper should be turned so as to give just enough draft through the water heater to take off the products of combustion.

B. May be due to an unfavorable angle of joining the flue connections.

Treatment—Insert a diaphragm as shown on page 25 and damper as in Cause A.

C. May be due to a very poor draft in the flue.

To find out if this is the cause, disconnect the water heater flue connection, tightly stopping the hole where it was connected and observe the action of the other appliance.

Treatment—Connect the heater to another flue; if none is available call in a flue expert.

D. May be due to a choked flue.

Treatment—Complaint No. 13.

No. 17. Heater lights up when no water is being drawn.

A. May be due to sticking of water valve plunger.

To find out if this is the cause, note whether water valve stem is in forward position; shut off the cold water inlet valve and observe whether water valve stem recedes. If it does not the valve plunger is stuck. The heater has been operating under the control of the thermostat only.

Treatment—Remove the valve cap and withdraw plunger and stem. The plunger may be jammed too tight to be moved by hand, in which case it should be tapped with a hammer lightly with a block of wood between the plunger and hammer. If this fails to release it, the valve cap and disc should be removed from the upper gas valve, the stem pushed against the water valve stem, a block of wood held against the gas valve stem and the plunger dislodged by being driven out with a hammer. When the plunger is out it should be rubbed with a piece of crocus cloth held taut on a flat piece of wood. The interior of the valve should be similarly treated.

If any hard spots are noticed on the plunger they should be given very careful and very light treatment with a flat file.

The cold water line should be disconnected to relieve any possible strain on the valve body. The little holes

piercing the plunger from front to back should be cleaned out. The valve should then be reassembled and it should be found to work easily when tested by hand.

The cold water line should then be reconnected, any strain having been removed, and the action of the valve tested by faucet action.

B. It may be due to an unsuspected faucet being open or leak in the hot water line.

To find out if this is the cause, close water inlet valve to heater, then open the valve. If the heater operates normally after repeating the test several times and all known faucets are closed, there is water flowing somewhere.

Treatment—Trace the hot water lines until the flowing water is found and shut off. As suggestions where to find this trouble the following cases from actual experience are given:

Leak in hot water line under cement floor of cellar, detected by warmth of floor at that point.

Closet flush tank connected by mistake to hot water line.

Boiler feed line in garage connected to hot water line.

Laundry tray bibb open and lids down with clothes piled on them.

Forgotten sink in closet on upper floor running.

C. May be due to disc of upper gas valve leaking or having been removed.

To find out if this is the cause, after disposing of Causes A and B, remove cap from upper gas valve and examine.

Treatment—If the disc leaks, replace washer; if seat leaks replace body, and if disc is missing replace it.

No. 18. Heater lights up when cold water is shut off.

A. May be due to air in the hot water line.

To find out if this is the cause, open each hot water faucet until the hot water flows steadily, then close the faucet. Then open a cold water faucet, and after it has been open a few seconds close the inlet valve to the heater. Close the cold water faucet. After it has been closed a few seconds, open the inlet valve to the heater. If upon opening the valve the heater does not light up, open and close the cold water faucet several times; if the heater does not light up the trouble is probably cured. If the water valve stem moves forward for a few seconds and recedes when the inlet valve is opened, it is proof that there is still air in the line.

Treatment—Repeat the opening of all faucets and if this fails to cure the trouble carefully trace the hot water line to see if there are any dead ends of pipe that could contain air. If any are discovered loosen the caps or plugs that close them and release the air tightening them up again when water appears. It would be well, if permitted, at this time to cut these dead ends off the main line to avoid further trouble.

B. May be due to insufficient supply of cold water.

To find out if this is the cause, open each hot water faucet until water runs steadily, then close the faucet. Then open and close cold water faucet on top floor and note whether there is a forward movement of the water valve stem. If there is, the trouble is air in the hot water line, see cause A. If there is no forward movement of the water valve stem, open a cold water faucet on the lower floor and after it has been open for one minute close the inlet valve to the heater. It will be noted that when the cold water faucet is opened the flow is large, but that it

diminishes after a short interval. Then close the cold water faucet and, after a few seconds, open the inlet valve to the heater. It will be noted that the water valve stem immediately moves forward but will recede when the inlet valve is closed and move forward again when the valve is opened a second time.

This trouble is not always easy to distinguish from Cause A. The principal difference is that Cause A may happen in conjunction with high water pressure and good flow from the faucets while this trouble is never present where they exist.

The explanation is, that the lower cold water faucets will pass, not only all the water they can get from the cold water main, but also the hot water which, when the pressure is removed from the cold water line, drops down backward through the heater into the cold water line and out at the faucet. When the faucet is closed the hot water line refills and the water to refill the line passes forward through the heater, lighting it.

Treatment—Enlarge cold water service. If this is not possible put check valve on outlet line from heater, if not already on. If check valve is on line be sure it is seating tightly. It is sometimes necessary to put check valves on each riser at the point where they are taken off the main.

C. May be due to reaction.

To find out if this is the cause, open a cold water faucet and close it quickly. A forward movement of the water valve stem takes place at once, but immediately the stem recedes. Open the cold water faucet again but this time close it very slowly and gently. No action of the water valve takes place. Again open the cold water faucet, and, while it is open, close the inlet valve to the heater. Then close the faucet quickly. In a few seconds

open the inlet valve to the heater. No action of the water takes place.

The explanation is, that the sudden stopping by the closing of the faucet, of a rapidly moving column of water generates a great water pressure in the cold water line. The hot water line is under but normal pressure and contains some air at all times. Hence the sudden increase of pressure on the cold water line forces the water valve plunger foward momentarily until the pressure is equalized.

Treatment—Install an air chamber on the cold inlet line of the heater. This consists of about three feet of three inch pipe with an air tight cap. This air chamber should be placed vertically with the sealed end at the top. The cap should be soldered tight. The pressure generated by the closing of the faucet will be dissipated in the air chamber and will not affect the water valve.

No. 19. The coils of heater rattle and pound when a faucet is closed.

A. Must be due to high water pressure and quick closing of faucets.

Treatment—Wire the coils rigid, and advise customer to close faucets gently. This trouble is usually accompanied by similar noise in water piping.

No. 20. Coils of heater rattle and vibrate for long periods.

A. Must be due to vibrations from external source.

Treatment—If vibrations are due to loose washer on fixture, replace washer. If due to transmission along water main of pulsations of pumps at city pumping station, in a factory or mill nearby, or organ motor, install air chamber as described in Complaint No. 19, Cause A. The

installation of a pressure regulator on cold water main is sometimes beneficial. Coils may be wired rigid to reduce noise.

No. 21. Pilot light goes out.

A. May be due to gummy deposit on pilot valve.

Treatment—Take out plug of valve, wipe clean and replace.

B. May be due to water or condensation in pilot line.

Treatment—Take down line and blow clear.

C. May be due to excessive speed of water valve action.

Treatment—Screw in speed regulator until proper speed is secured, or put in stronger spring.

D. May be due to too low an adjustment.

Treatment—Turn on more gas to pilot.

E. May be due to poor draft in flue.

Treatment—Complaint No. 13.

F. May be due to defective gas meter.

Treatment—Install new gas meter.

G. May be due to insufficient gas supply.

Treatment—Complaint No. 12.

No. 22. Flames come out at bottom of heater.

A. May be due to poor flue.

Treatment—Complaint No. 13.

B. May be due to choked draft hood.

Treatment—Replace it.

C. May be due to carbonized coils or burners.

Treatment—Clean heater.

No. 23. Heater turns off gas too slowly.

A May be due to air in hot water line.

To find out if this is the cause, see Complaint No. 18, Cause A.

Treatment—Complaint No. 18, Cause A.

B. May be due to insufficiency of cold water supply.

To find out if this is the cause, see Complaint No. 18, Cause B.

Treatment—Complaint No. 18, Cause B.

C. May be due to clogged water valve.

To find out if this is the cause, see Complaint No. 17, Cause A.

Treatment—Complaint No. 17, Cause A.

D. May be due to choking of the leakage ports in the water valve plunger.

Treatment—Take out plunger and clean out holes. If necessary enlarge them with a reamer.

No. 24. Heater has slight explosions occasionally.

A. May be due to low position of Pilot Burner.

Treatment—Raise pilot burner until its flame orifices are just at the level or very slightly above the flame orifices of the main burners.

B. May be due to main burners being too far away from pilot burner.

This can be the case in old heaters only. In the later models the positions of the burners and the positioning ribs in the walls of the burner chamber make it impossible for the burners to get out of contact with the pilot burner.

Treatment—Place burners in proper positions and fasten them there with the set screws.

C. May be due to slight leak in upper gas valve accompanied by a poor flue.

To find out if this is the cause, test the valve as instructed in "Maintenance" under "Gas Valves."

Treatment—Complaint No. 17, Cause C, and Complaint No. 13.

No. 25. Thermostat does not hold adjustment.

A. Must be due to broken porcelain rod.

Treatment—Replace with new porcelain rod.

No. 26. Burners get dirty too often.

A. May be due to excessive amount of dust in air. Sometimes the case when a heater is located close to ash-pit.

Treatment—Re-locate heater, if possible.

B. May be due to poor flue.

Treatment—Complaint No. 13.

No. 27. Condensation overflows pan of heater.

A. Due to heavy condensation on account of heavy use of heater.

Treatment—Make permanent drain connection or connect a nipple to the pan and let it terminate in the cinder filling below the cement floor of the cellar.

No. 28. Pounding in coils of Multi-Coil Storage Heater.

A. May be due to clogged coils.

Treatment—See "Maintenance" under "Coils."

B. May be due to high adjustment of Moment Valve.

Treatment—Lower the adjustment.

No. 29. Hot water is exhausted from an automatic Storage System before Moment Valve opens the gas valve.

A. May be due to too low an adjustment of Moment Valve. The range of temperature on these valves is about 30 degrees from high shut-off point to the low turn-on point.

Treatment—Adjust the valve to a higher temperature.

No. 30. Hot water is exhausted from an automatic storage system.

A. May be due to low adjustment of Moment Valve.

Treatment—Complaint No. 29.

B. May be due to load exceeding capacity of heater.

To find out if this is the cause, note whether heater lights up soon after faucet is opened and estimate amount of water drawn.

Treatment—Install larger system.

No. 31. Water too hot when first drawn after a period when no water has been used. Sometimes steam appears in place of hot water.

A. May be due to too high an adjustment of pilot burner.

Treatment—Adjust pilot burner correctly.

No. 32. Water too hot, sometimes steam.

A. May be due to too high an adjustment of thermostat.

Treatment—Reduce temperature regulation of thermostat.

B. May be due to lock nuts on thermostatic gas valve stem having been tampered with.

To find out if this is the cause, examine lock nuts and stem. Take off lock nuts, allowing stem and disc to

seat tightly, at the same time testing valve for tightness by the method described for upper gas valve in "Maintenance" under "Gas Valves," but removing disc from upper gas valve. When valve is proven or made tight, replace one of the hexagon nuts on the stem with the long lever in place and run the nut up on the stem. Set the nut so that, when the stem and disc are tight against the seat of the valve, the end of the lever has a play of about one-eighth of an inch between the stuffing cap and the nut. Then run the other nut up, locking both nuts, being careful not to disturb the position of the first nut in the process. The thermostat should then be readjusted to the proper temperature.

C. May be due to heat from some other source. This is possible only on the reheating system.

To find out if this is the cause, note when steam or too hot water flows that the heater is not burning. This proves that the steam or hot water is merely passing through the heater and is not generated by it.

Treatment—Advise that a plumber be called in to remedy the trouble.

No. 33. Hot water from cold water faucets.

A. May be due, in a return circulation system, to the hot water line and cold water line running for some distance in contact.

Treatment—Change piping.

B. May be due to wrong connection, the plumber having connected the hot water line to the cold water faucet.

Treatment—Change the indices on the faucets or advise customer of situation.

C. May be due to hot water, by passing at shower bath, if one is in use.

Treatment—Close shower valve.

No. 34. Water in boiler will not get hot.

A. May be due to leaking relief valve, if one is installed, or other hidden outlets.

To find out if this is the cause, note at the valve or at the end of the waste line from relief valve, if water flows continuously.

Treatment—Repair valve if it is leaking or readjust if it is set too low.

No. 35. Circulation System does not circulate.

A. Must be due to causes not in heater.

Treatment—Advise that plumber be called in to cure the trouble. The heater, if it heats water, can not possibly have anything to do with the working or not working of a return circulation system.

No. 36. Water in boiler of Storage System hot, but no hot water at faucets.

A. May be due to cold water entering the line at some other point.

To find out if this is the cause, see Complaint No. 5, Cause A.

Treatment—Complaint No. 5, Cause A.

B. May be due to broken or missing cold water tube in boiler.

To find out if this is the cause, disconnect cold water line at top of boiler and examine.

Treatment—Put in new tube.

C. May be due to connection of cold water line to hot water outlet of boiler.

To find out if this is the cause, turn on a faucet and note that the line which should feel hot feels cold.

Treatment—Correct the connections.

General Notes on Troubles

It has been assumed in treating of water heater troubles that in all cases, except a very few, the heater has been properly located, connected and adjusted. This cannot, however, be assumed by the man who is called in to find the trouble in any particular complaint.

The very first thing, then, that should be ascertained in the case of a complaint is whether the heater is properly installed. The troubles that arise from improper installation are at once obvious to anyone who has given this book careful study.

After the installation has been noted, the trouble man should, like a good physician, endeavor by tactful questions and conversation to bring out the symptoms of the case. It is possible, sometimes, of course, to test the flow, valve action and heater generally and find out the trouble, and this should always be done. But it is almost a certainty that a water heater, like any other bit of machinery, will never misbehave when it is wanted to. When all the information is secured that it is possible to obtain from the complainant or members of the household about the trouble, existing conditions as to pressure, water flow, valve action, etc., should be carefully noted.

The next step in the procedure is to think. "Thought should always precede action." This is no where so true as in the case of trailing water heater troubles. Plenty of time should be given to classifying the information secured and results of tests made. When this is done the chances are excellent that the complaint will be found listed in one or more places in the preceding paragraphs.

The thinking step is most important. "Fools rush in where angels fear to tread." The sure sign of a novice at this work is the readiness and confidence with which he proceeds to attack the heater, change its adjustment or tamper with its mechanism without the slightest hesitation, when the experienced man, by taking thought, would have determined that the trouble was not in the heater at all.

When the true complaint is found, the remedy as described should be applied and the heater left in perfect adjustment.

Where the Gas Goes

In order to dispel the erroneous impression in the mind of most prospective buyers that it takes a lot of gas to operate a Ruud Automatic Water Heater, the following table is presented of an actual installation of a No. 4 Ruud Heater, in a residence having three bath tubs, kitchen sink, and three lavatories. The family consists of three adults, two children, and three servants. It will be noted that the operating cost for the Ruud, including the pilot light, averaged $2.73 per month during a period of eighteen months. This surely could not be considered excessive for an ample supply of hot water always ready at the turn of the faucet.

NOTE—Gas tests 650 B. T. U. Cost $1.00 per 1,000 cubic feet.

MONTH	Total Gas Bill	Clothes Dryer and Gas Logs	Lighting and Range	RUUD Including Pilot	Pilot
April.....	$7.10	$1.10	$2.80	$3.20	.40
May.....	5.30	.50	1.90	2.90	.50
June.....	6.40	.60	4.40	1.40	.40
July.....	5.70	.40	4.70	.60	.30
August.....	6.20	1.00	4.00	1.20	.30
September.....	6.80	....	3.60	3.20	.30
October.....	5.50	.70	2.80	2.00	.30
November.....	2.70	.50	1.20	1.00	.30
December.....	4.50	.50	1.90	2.10	.20
January.....	9.20	1.40	5.00	2.80	.30
February.....	4.70	.90	1.20	2.60	.30
March.....	5.60	.90	1.60	3.00	.30
April.....	7.40	1.20	1.90	4.30	.30
May.....	6.40	1.20	2.50	2.70	.30
June.....	4.20	.10	1.60	1.50	.40
July.....	8.80	.60	4.50	3.70	.30
August.....	8.40	.40	4.10	3.00	.30
September.....	6.90	.20	2.50	4.20	.20

Industrial Installations

Since the Ruud line of water heaters first appeared hundreds of uses have been found for the various heaters quite apart from the original purpose of domestic use or furnishing hot water for toilet or kitchen purposes.

In many processes in the arts and industries hot water is needed quickly and in quantity. Needless to say, wherever hot water is needed the Ruud, of some type or size, can supply it. The particular size and type of heater must be selected with a view to the local conditions surrounding the installation.

Many other uses have been found for the heater besides furnishing of hot water. It is impossible to enumerate these uses, but as suggestions it may be of interest to know that Ruuds to-day and everyday are:

Super-heating steam for Calendar Rolls in cloth-printing establishments.

Boiling hams and frankfurters in delicatessen stores.

Holding evaporating ovens at exact heats for manufacturers of biological products—Sour milk tablets, etc.

Sterlizing milk and beer.

Blowing out and cleaning beer pipes in saloons and breweries.

Hot Water Jacketing process cauldrons.

The purpose of the words on this subject is not so much to tell how the Ruud may be used but to extend a really sincere invitation to any interested reader to place his problem with us for analysis and specification of proper size and type of Ruud for the purpose. Our engineering department has data collected from the entire world and experience memoranda covering nearly thirty years of our business history to draw from. We have learned how the Ruud Water Heater may be used and, what is still more important, how it may not be used. If a Ruud can be used we will advise the size, type and plan of installation, and if it cannot be used successfully we will frankly say so.

The Ruud Burner

"Separable Flat Top Burner"

Patent No. 761,409

By

J. CRAWFORD BARTLETT

In gas appliances, all other things being equal, that appliance which has a burner reliable under all conditions of varying gas pressures and compositions, will be the one crowned with SUCCESS.

As is well known, the majority of appliances fail from burner troubles, of which "flashing back" is the most common, and "burning out" the next largest cause. Not to dip too deeply into the theory of gas burners, suffice it to say that "flashing" can only be prevented by the use of a "flame check." This "flame check" **must** consist of narrow slots or holes, and its **entire usefulness** depends upon its **being kept cooler than the igniting point of the gas.** Let it become heated to the "flash point" and the burner will flash back. Under that condition it will, and must flash, and it can't do otherwise.

Let us examine the sectional view of the Ruud Burner.

At **A** the gas issues from the small orifice in the brass burner spud drawing in air at the inlet **B**. The mixture passes through the flame-check **C** (a piece of finely perforated copper having an aggregate area of openings many times larger than required to pass the quantity necessary) into the burner top **D**, and issues at the mouth **E**, forming the long perfect flames **F** peculiar to the Ruud.

It will be readily seen that as the **flame does not burn against the flame-check, the check cannot be heated to the flash point.** Considerable heat is transmitted down the burner through the metal, which would tend to heat up the check, and, in time, the entire burner. The dotted arrows illustrate how part of this heat is

thrown off by radiation; and the currents of cool air **GG** passing over every part of the burner surface, take up the remainder of the heat and keep the burner cool under the most trying conditions

As dust is bound, in time, to collect in all available places, it is very necessary to have some means of readily cleaning the burner.

A glance at the cuts shows what a simple matter it is to loosen the two brass bolts, thereby releasing the burner top from the burner body, between which is clamped the check. This check can then be readily cleaned and the burner reassembled, and it is good for another year or two.

Evidencing the claims made and established for this burner, it is but necessary to examine a burner which has seen service, and the **black asphalt varnish** with which it is coated **will be found in perfect condition,** except right at the mouth of the burner.

Capacities of Heaters

In Gallons per Minute, Delivered by Ruud Instantaneous Automatic Water Heaters
Ruud Instantaneous Automatic Cottage Water Heaters

TEMPERATURE RAISE

Size of Heater	50°	60°	70°	80°	90°	100°	110°	120°	130°	140°	150°
No. 1½	1.89	1.57	1.35	1.18	1.05	.95	.86	.78	.73	.68	.63
No. 2½	3.15	2.62	2.25	1.97	1.75	1.58	1.43	1.31	1.21	1.12	1.05
No. 3	3.78	3.15	2.70	2.36	2.10	1.89	1.72	1.58	1.45	1.35	1.26
No. 4	5.05	4.20	3.60	3.15	2.80	2.52	2.29	2.10	1.94	1.80	1.68
No. 6	7.58	6.30	5.40	4.73	4.20	3.87	3.52	3.23	2.98	2.76	2.58
No. 8	10.10	8.40	7.20	6.30	5.60	5.04	4.59	4.20	3.88	3.60	3.36
No. 60	1.89	1.57	1.35	1.18	1.05	.95	.86	.78	.73	.68	.63
No. 65	2.57	2.09	1.80	1.57	1.40	1.26	1.15	1.04	.97	.90	.84
No. 70	3.15	2.62	2.25	1.97	1.75	1.58	1.43	1.31	1.21	1.12	1.05

Gallons per Hour Delivered by Multi-Coil Storage Heater

TEMPERATURE RAISE

Size of Heater	50°	60°	70°	80°	90°	100°	110°	120°	130°	140°	150°
No. 100	126	105	90	78.8	70	63	57.2	52.5	48.4	45	42
No. 200	252	210	180	157.5	140	126	114.5	105	97	90	84
No. 300	378	315	270	236	210	189	172	158	145	135	126
No. 400	505	420	360	315	280	252	229	210	194	180	168
No. 500	630	525	450	394	350	315	287	262	242	225	210

Flow of Water through Low Pressure Instantaneous Heater

Having Various Lengths in Feet of Pipe in Service Line

Pressure		20 Feet ¾" Water Pipe			40 Feet ¾" Water Pipe			60 Feet ¾" Water Pipe			80 Feet ¾" Water Pipe			100 Feet ¾" Water Pipe		
		Gallons per Min.			Gallons per Min.			Gallons per Min.			Gallons per Min.			Gallons per Min.		
In lbs.	In Feet	No. 4	No. 6	No. 8	No. 4	No. 6	No. 8	No. 4	No. 6	No. 8	No. 4	No. 6	No. 8	No. 4	No. 6	No. 8
3	6.9	1	1.4	1.9	0.9	1.25	1.7	0.8	1.1	1.55	0.7	0.95	1.4	0.65	1.2	1.2
4	9.2	2	2.3	2.6	1.85	2.1	2.4	1.7	1.9	2.15	1.55	1.7	1.9	1.4	1.5	1.7
5	11.5	2.3	3.6	3.8	2.15	3.45	3.6	2.05	3.25	3.35	1.9	3.1	3.2	1.8	2.9	3.0
6	13.8	3	4.3	4.4	2.9	4.	4.2	2.8	3.75	4.0	2.7	3.5	3.8	2.6	3.2	3.6
7	16.2	3.6	4.7	4.8	3.45	4.4	4.6	3.25	4.15	4.45	3.2	3.9	4.15	3.1	3.7	3.9
8	18.5	3.9	5.6	5.7	3.8	5.45	5.5	3.65	4.8	5.1	3.5	4.45	4.8	3.4	4.1	4.6
9	20.8	4.6	5.8	6.1	4.45	5.6	5.75	4.3	5.1	5.45	4.15	4.75	5.1	4.0	4.4	4.8
10	23	5	6.5	6.8	4.9	6.05	6.4	4.75	5.65	6	4.65	5.2	5.6	4.5	4.8	5.3

Table

Flow in Gallons per Minute Delivered by Ordinary Plumbing Fixtures

Fixture	Fair Flow	Good Flow	Excellent Flow
Kitchen Sink Bibbs	2	4	6
Pantry Sink—High Goose Neck Bibbs	2	2	3
Pantry Sink—Large Plain Bibbs	4	6	8
Vegetable Sink Bibbs	2	4	6
Laundry Tray Bibbs	4	6	8
Slop Sink Bibbs	3	4	6
Lavatory Basin Bibbs	2	3	4
Bath Tub Bibbs	3	4	6
Shampoo Spray	½	1	2
Liver Spray	1	2	3
Shower Baths			
5″ Rain Heads	2	3	4
6½″ Rain Heads	2	3	5
8″ Rain Heads	4	6	8
8″ Tabular Heads	6	8	10
Needle Baths	20	30	40
Manicure Tables	1	1½	2

This table was compiled from actual tests on a water pressure of 30 pounds per square inch. It is intended to set forth what is, in our opinion, only a proper flow from the fixtures. It does not give the largest flow possible in any case. That is governed by the water pressure. Differences will be found among similar fixtures made by different manufacturers. In explanation of the three rates of flow listed, it should be noted that by "Fair Flow" is meant a stream just large enough to render what might be called good service, by "Good Flow" is meant a stream which in most households would be entirely satisfactory and by "Excellent Flow" is meant a flow which, if increased to any great extent would cause annoyance by splashing and noise.

We desire to acknowledge our indebtedness for assistance rendered in compiling this table to Messrs. Woodward and Wanger, Philadelphia, and the Speakman Supply and Pipe Company, Wilmington, Delaware.

Flow of Water in House-Service Pipes

(Thomson Meter Company)

Condition of discharge	Press. in main, pounds per sq. in.	Discharge in cubic feet per minute — Nominal internal diameter of pipe (inches)							
		½	¾	1	1¼	2	3	4	6
Through 35 feet of service pipe, no back pressure	30	1.10	3.01	6.13	16.58	33.34	88.16	173.85	444.63
	40	1.27	3.48	7.08	19.14	38.50	101.80	200.75	513.42
	50	1.42	3.89	7.92	21.40	43.04	113.82	224.44	574.02
	60	1.56	4.26	8.67	23.44	47.15	124.68	245.87	628.81
	75	1.74	4.77	9.70	26.21	52.71	139.39	274.89	703.03
	100	2.01	5.50	11.20	30.27	60.87	160.96	317.41	811.79
	130	2.29	6.28	12.77	34.51	69.40	183.52	361.91	925.58
Through 100 feet of service pipe, no back pressure	30	0.66	1.84	3.78	10.40	21.30	58.19	118.13	317.23
	40	0.77	2.12	4.36	12.01	24.59	67.19	136.41	366.30
	50	0.86	2.37	4.88	13.43	27.50	75.13	152.51	409.54
	60	0.94	2.60	5.34	14.71	30.12	82.30	167.06	448.63
	75	1.05	2.91	5.97	16.45	33.68	92.01	186.78	501.58
	100	1.22	3.36	6.90	18.99	38.89	106.24	215.68	579.18
	130	1.39	3.83	7.86	21.66	44.34	121.14	245.91	660.36
Through 100 feet of service pipe and 15 feet vertical rise	30	0.55	1.52	3.11	8.57	17.55	47.90	97.17	260.56
	40	0.66	1.81	3.72	10.24	20.95	57.20	116.01	311.09
	50	0.75	2.06	4.24	11.67	23.87	65.18	132.20	354.49
	60	0.83	2.29	4.70	12.94	26.48	72.28	146.61	393.13
	75	0.94	2.59	5.32	14.64	29.96	81.79	165.90	444.85
	100	1.10	3.02	6.21	17.10	35.00	95.55	193.82	519.72
	130	1.26	3.48	7.14	19.66	40.23	109.82	222.75	597.31
Through 100 feet of service pipe and 30 feet vertical rise	30	0.44	1.22	2.50	6.80	14.11	38.63	78.54	211.54
	40	0.55	1.53	3.15	8.68	17.79	48.68	98.98	266.59
	50	0.65	1.79	3.69	10.16	20.82	56.98	115.87	312.08
	60	0.73	2.02	4.15	11.45	23.47	64.22	130.59	351.73
	75	0.84	2.32	4.77	13.15	26.95	73.76	149.99	403.98
	100	1.00	2.75	5.65	15.58	31.93	87.38	177.67	478.55
	130	1.15	3.19	6.55	18.07	37.02	101.33	206.04	554.96

To obtain flow in gallons per minute, multiply values given in table by 7.48

Water

1 cubic inch..... = 0.0361 lbs.
27.71 cubic inches..... = 1.00 lbs.

2.035 inches of mercury.. = 1.00 lbs. pressure.
27.71 inches of water.... = 1.00 lbs. pressure per sq. inch.
1 inch of water..... = 0.036125 lbs. pressure per sq. inch.
1.731 inches water..... = 1 ounce.
1 foot water..... = .433 lbs.

1 cubic foot..... = 7.48 gallons.
= 1728 cubic inches.
= 62.4245 lbs. at 39° F.

1 U. S. GALLON..... = 8.3311 lbs. distilled.
= 8.34 lbs. ordinary.
= 231 cubic inches.
= 0.1337 cubic feet.

1 IMPERIAL GALLON. = 10.00 lbs. at 62°
= 277.274 cubic inches.

1 litre..... = 61.02 cubic inches.
1 cubic meter..... = 35.31 cubic feet.
1 cubic foot..... = 28.317 litres.

1 cubic foot pure water weighs at

32°	F.	62.418 lbs.
39.1°	F.	62.425 lbs.
62°	F.	62.355 lbs.
212°	F.	59.76 lbs.

Water Pressure per Square Inch

Feet head	Press. per sq. in. Lbs.	Feet head	Press. per sq. in. Lbs.	Feet head	Press. per sq. in. Lbs.	Feet head	Press. per sq. in. Lbs.
1	0.43	22	9.53	43	18.62	64	27.72
2	0.86	23	9.96	44	19.05	65	28.15
3	1.30	24	10.39	45	19.49	66	28.58
4	1.73	25	10.82	46	19.92	67	29.02
5	2.16	26	11.26	47	20.35	68	29.45
6	2.59	27	11.69	48	20.79	69	29.88
7	3.03	28	12.12	49	21.22	70	30.32
8	3.46	29	12.55	50	21.65	71	30.75
9	3.89	30	12.99	51	22.09	72	31.18
10	4.33	31	13.42	52	22.52	73	31.62
11	4.75	32	13.86	53	22.95	74	32.05
12	5.20	33	14.29	54	23.39	75	32.48
13	5.63	34	14.72	55	23.82	76	32.92
14	6.06	35	15.16	56	24.26	77	33.35
15	6.49	36	15.59	57	24.69	78	33.78
16	6.93	37	16.02	58	25.12	79	34.21
17	7.36	38	16.45	59	25.55	80	34.65
18	7.79	39	16.89	60	25.99	81	35.08
19	8.22	40	17.32	61	26.42	82	35.52
20	8.66	41	17.75	62	26.85	83	35.95
21	9.09	42	18.19	63	27.29	84	36.39

Pressures and Boiling Points of Water for Given Static Heads

Height of Column, Feet	Pressure per Square Inch, Pounds	Boiling Point, Degrees Fahrenheit
2	0.866	214.9
3	1.299	216.3
4	1.732	217.6
5	2.165	219.0
6	2.598	220.3
7	3.031	221.6
8	3.464	222.8
9	3.897	224.3
10	4.330	225.3
15	6.495	231.0
20	8.660	236.2
25	10.825	241.2
30	12.990	245.7
35	15.155	249.9
40	17.320	253.8
45	19.485	257.7
50	21.650	261.3
60	25.980	268.0
70	30.310	274.3
80	34.640	280.0
90	38.970	285.3
100	43.300	290.3

The Equivalents of Ounces, per Square Inch, in Inches of Height of Columns of Water and Mercury

27.71 inches of water or 2.04 inches of mercury equal 1 lb. per square inch at atmospheric pressure and 62 degrees Fahrenheit temperature. Mercury is 13.58 times as heavy as water.

Ounces	Inches of Water	Inches of Mercury
1	1.73	.127
2	3.46	.255
3	5.20	.382
4	6.93	.510
5	8.66	.637
6	10.39	.765
7	12.12	.892
8	13.85	1.019
9	15.59	1.148
10	17.32	1.275
11	19.05	1.402
12	20.78	1.531
13	22.52	1.658
14	24.25	1.786
15	25.98	1.913
16	27.71	2.035

Average Compositions of Various Gases Giving Heating Value, Weight and other Constants

Average Compositions Per cent. by volume		Illuminating Gas	Oil Gas*	Anthracite Producer Gas	Bituminous Producer Gas‡	Blast Furnace Gas	Coke Oven Gas	Natural Gas Anderson, Ind.	Water Gas
CO	Carbon Monoxide...	5.60	8.9	27.0	27.0	26.0	7.0	0.73	45.0
H_2	Hydrogen	49.95	5.6	12.0	12.0	3.0	55.0	1.86	45.0
CH_4	Marsh Gas.....	34.68	54.9	1.2	2.5	0.5	32.0	93.07	2.0
C_2H_4	Ethylene	4.20	28.9	....	0.4	....	1.5	0.47	....
CO_2	Carbon Dioxide.....	0.60	0.9	2.5	2.5	9.5	1.2	0.26	4.0
N_2	Nitrogen	4.57	....	57.0	56.2	56.0	1.5	3.04	2.0
O_2	Oxygen	0.40	....	0.3	0.3	....	....	0.42	0.5
H_2O	Water (vapor).....	....	....	....	....	5.0	1.0	....	....
Weight, lbs. per cu. ft.....		0.031	0.058	0.065	0.065	0.079	0.027	0.046	0.045
Higher heating value, B. T. U. per cu. ft.....		632	1,120	147	168	104	580	1,010	330
Per Pound.....		20,450	19,300	2,260	2,590	1,321	21,500	22,000	7,350
Minimum air required for Comb., cu. ft. per cu. ft....		5.25	9.5	1.00	1.15	0.7	5.0	9.0	2.3

*Made by vaporizing crude oils. Should be distinguished from the water-oil gas made by the Lowe process.

‡These analyses are from an R. D. Wood catalogue. The composition of producer gas may vary over wide ranges; thus Guldner gives the following for an anthracite gas: 16.6 per cent CO, 24.2 per cent H_2; 2 per cent CH_4; 11.3 per cent CO_2; 45.9 per cent N_2.

Authority, Experimental Engineering.

Approximate Comparative Cost of Different Fuels

Kind of Gas	No. of Heat-units in 1000 cu. ft. used	No. of Heat-units in furnaces after deducting 25% loss	Average cost per 1000 feet	Cost of 1,000,000 Heat-units obtained in furnaces
Natural gas	1,000,000	750,000	$0.25	$0.335
Coal-gas, 20 candle-power	675,000	506,250	1.25	2.46
Carburetted water-gas	646,000	484,500	1.00	2.06
Water-gas from hard coal at $6.00 per ton	313,000	234,750	0.15	0.64
Producer-gas from hard coal at $6.00 per ton	150,000	112,500	0.05	0.45

Coal, $6.00 per ton, per 1,000,000 heat-units, utilized at 50% efficiency.....$0.480
Crude petroleum, 3c per gal., per 1,000,000 heat-units, utilized at 75% efficiency..... 0.335

Constants for Fuel Gases, Air Required for Combustion, Heating Values, Etc.

GAS	Formula	Density Air = 1.0	Wt. per Cu. Ft. at 29.32" and 32° F. Hg	Higher Heating Value, B. T. U. per Lb.	Lower Heating Value, B. T. U. per Lb.	Higher Heating Value, B. T. U. per Std. Cu. Ft.	Lower Heating Value, B. T. U. per Std. Cu. Ft.	Theoretical Am't of Oxygen Per Lb. of Gas Lbs.	Theoretical Am't of Air for 1 lb. of gas Lbs.	Theoretical Am't of Air for 1 cu. ft. of gas Cu. Ft.	Lbs. Products of Comb. per lb. of gas CO_2	Lbs. Products of Comb. per lb. of gas H_2O	Lbs. Products of Comb. per lb. of gas N_2
Hydrogen	H_2	0.06950	.00561	61,950	52,500	345	294	8.00	34.78	2.40	....	9.00	26.78
Carbon Monoxide	CO	0.96700	.07807	4,380	4,380	342	342	.57	2.48	2.38	1.57	....	1.91
Marsh Gas	CH_4	0.55400	.04464	23,840	21,380	1,067	955	3.99	17.30	9.56	2.74	2.25	13.31
Acetylene	C_2H_2	0.91500	.07251	21,430	20,670	1,582	1,499	3.07	13.35	11.99	3.38	0.69	10.28
Ethylene	C_2H_4	0.97400	.07809	21,430	20,020	1,685	1,564	3.43	14.95	14.58	3.14	1.29	11.52
Ethane	C_2H_6	1.03670	.08378	22,400	20,430	1,873	1,712	3.72	16.17	16.76	2.92	1.80	12.45
Nitrogen	N_2	0.96700	.07831	.....	.....	....	....	....	.....	.....	....	....	.....
Oxygen	O_2	1.10520	.08921	.....	.....	....	....	....	.....	.....	....	....	.....
Carbon Dioxide	CO_2	1.51970	.12268	.....	.....	....	....	....	.....	.....	....	....	.....
Air	Air	1.00000	.08072	.....	.....	....	....	....	.....	.....	....	....	.....

AUTHORITY—EXPERIMENTAL ENGINEERING

Gasoline

Specific gravity of liquid = 0.66.

Boiling point of liquid = 158° to 176° F.

Density of 59° F. = 80° to 78° Beaume'.

Weight of 1 gallon of gasoline = 5.478 lb.

1 lb. liquid contains 17,000 B. T. U., average.

Artificial gas contains 650 B. T. U. per cubic foot, average.

In 1 lb. liquid there are $\frac{17,000}{650} = 26$ cubic feet illuminating gas.

1 gallon liquid equals $26 \times 5.5 = 143$ cubic feet of illuminating gas.

7 gallons liquid = 1000 cubic feet illuminating gas.

Thus illuminating gas at $1.00 per 1000 cubic feet, having 650,000 B. T. U., would equal 7 gallons of gasoline at 14.3 cents per gallon.

"Gasoline gas" is generally produced by the so called "wet process." Size of machine for different sizes of water heaters as follows:

Size Gas Machines Required for Heater Only

10	Light	for	No. 1½	20	Light	for	No. 3
10	"	"	No. 2½	30	"	"	No. 4
10	"	"	No. 60	45	"	"	No. 6
10	"	"	No. 65	60	"	"	No. 8
10	"	"	No. 70	10	"	"	No. 100
10	"	"	No. 30-40	20	"	"	No. 200
10	"	"	No. 50-50	30	"	"	No. 300
10	"	"	No. 50-66	45	"	"	No. 400
10	"	"	No. 50-80	60	"	"	No. 500

Larger machine is required if there are other fixtures.

Caps should have No. 36 orifice at least.

Table showing Correct Sizes of House Pipes for Different Lengths of Pipes and Number of Outlets

(Denver Gas and Electric Company)

Number of Outlets	Length of Pipe in Feet								
	⅜" Pipe	½" Pipe	¾" Pipe	1" Pipe	1¼" Pipe	1½" Pipe	2" Pipe	2½" Pipe	3" Pipe
1	20	30	50	70	100	150	200	300	400
2	..	27	50	70	100	150	200	300	400
3	..	12	50	70	100	150	200	300	400
4	..	..	50	70	100	150	200	300	400
5	..	..	33	70	100	150	200	300	400
6	..	..	24	70	100	150	200	300	400
8	..	..	13	50	100	150	200	300	400
10	..	..	..	35	100	150	200	300	400
13	..	..	..	21	60	150	200	300	400
15	..	..	..	16	45	120	200	300	400
20	..	..	..	..	27	65	200	300	400
25	..	..	..	..	17	42	175	300	400
30	..	..	..	..	12	30	120	300	400
35	..	..	..	..	...	22	90	270	400
40	..	..	..	..	...	17	70	210	400
45	..	..	..	..	...	13	55	165	400
50	..	..	..	..	...	...	45	135	330
55	..	..	..	..	...	...	27	80	200
75	..	..	..	..	...	...	20	60	150
100	..	..	..	..	...	...	...	33	80
125	..	..	..	..	...	...	...	22	50
150	..	..	..	..	...	...	...	15	35
175	..	..	..	..	...	...	...	...	28
200	..	..	..	..	...	...	...	...	21
225	..	..	..	..	...	...	...	...	17
250	..	..	..	..	...	...	...	...	14

In this table the quantity of gas the piping may be called upon to convey is stated in terms of ⅜ inch outlets on the assumption that each outlet requires a supply of 10 cubic feet per hour. The aim of the table is to have the loss in pressure not exceed 1/10 inch water pressure in 30 feet.

...e table the following rules should be

...out the size of pipe, always start at the ... work toward the meter.

...d not be supplied from a smaller to a larger

If the exact number of outlets given cannot be found in the table, take the next larger number. For example, 17 outlets are required to work with the next larger number in the table, which is 20. Or, if, for the number of outlets given, the exact length which feeds these outlets cannot be found in the table, the next larger length corresponding to the outlets given must be taken to determine the size of pipe required. Thus, if there are 8 outlets to be fed through 55 feet of pipe, the next larger than 55 in the 8 outlet line in the table, which is 100, should be used. As this is in the 1¼ inch column, that size pipe would be required.

For any given number of outlets, a smaller size should not be used than the smallest size that contains a figure in the table for that number of outlets. Thus, to feed 15 outlets, no smaller size pipe than 1 inch may be used, no matter how short the section of pipe may be.

In any continuous run from an extremity to the meter, there may not be used a longer length of any size pipe than found in the table for that size, as 50 feet of ¾ inch, 70 feet of 1 inch, etc. If any one section would exceed the limit length, it must be made of larger pipe.

If any outlet is larger than ⅜ inch it must be counted as more than one, in accordance with the following table:—

Size of Outlet (inches)	½	¾	1	1¼	1½	2	2½	3
Value in table.....	2	4	7	11	16	28	44	64

BOOK OF STANDARDS,
National Tube Company, 1913.

RULE for obtaining approximate size of House Heater.

Multiply width of house by length, then by height, divide by 25.

Maximum Supply of Gas through Pipes in Cubic Feet per Hour

Specific Gravity being taken at 0.45, calculated from the

Formula $Q = 1000 \sqrt{d^5 h \div sl.}$ (Molesworth.)

Length of Pipe = 10 yards.

Diam. of pipe, inches	Pressure by the Water Gauge in Inches									
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
⅜	13	18	22	26	29	31	34	36	38	41
½	26	37	46	53	59	64	70	74	79	83
¾	73	103	126	143	162	187	192	205	218	230
1	149	211	258	298	333	365	394	422	447	471
1¼	260	368	451	521	582	638	689	737	781	823
1½	411	581	711	821	918	1006	1082	1162	1232	1299
2	843	1192	1460	1686	1886	2066	2231	2385	2530	2667

Length of Pipe—100 Yards

Diam. of pipe, inches	Pressure by the Water Gauge in Inches									
	0.1	0.2	0.3	0.4	0.5	0.75	1.0	1.25	1.5	2.0	2.5
½	8	12	14	17	19	23	26	29	32	36	42
¾	23	32	42	46	51	63	73	81	89	103	115
1	47	67	82	94	105	129	149	167	183	211	236
1¼	82	116	143	165	184	225	260	291	319	368	412
1½	130	184	225	260	290	356	411	459	503	581	649
2	267	377	462	533	596	730	843	943	1033	1193	1333
2½	466	659	807	932	1042	1276	1473	1647	1804	2083	2329
3	735	1039	1270	1470	1643	2012	2323	2598	2846	3286	3674
3½	1080	1528	1871	2161	2416	2958	3416	3820	4184	4831	5402
4	1508	2133	2613	3017	3373	4131	4770	5333	5842	6746	7542

THE MECHANICAL ENGINEERS' POCKET-BOOK,
William Kent, M. E., Sc. D.

Flow of Gas through Orifices

Drill No. Morse Standard	Diameter Inches	Area Square Inches	Flow per Hour Cubic Feet 4″ Pressure	Flow per Hour Cubic Feet 3″ Pressure	Flow per Hour Cubic Feet 2″ Pressure	
52	0.0635	.003166	11.6	10.1	8.23	
50	0.07	.003848	13.1	11.4	9.30	
48	0.076	.004536	14.1	12.3	10.00	
46	0.081	.005184	15.2	13.2	10.77	
44	0.086	.005812	17.1	14.9	12.15	These tests
42	0.0935	.006833	20.5	17.8	14.52	at 3″ pres-
40	0.098	.00754	22.5	19.6	15.99	sure were
38	0.1015	.00811	24.8	21.6	17.6	made using
36	0.1065	.00882	26.1	22.7	18.52	natural gas
34	0.111	.00967	28.5	24.8	20.23	
32	0.116	.01056	31.8	27.6	22.52	
30	0.1285	.01227	37.9	33.0	26.93	
28	0.1405	.0156	43.7	36.7	30.00	
26	0.147	.017	51.7	43.4	35.60	
24	0.152	.0181	65.0	57.5	46.88	These tests
22	0.157	.0192	70.0	61.0	49.77	at 3″ pres-
21	0.159	.0199	73.5	64.0	52.22	sure were
20	0.161	.0203	74.5	65.2	53.22.	made using
19	0.166	.0217	81.0	70.5	57.52	artificial gas

Values of 3-inch pressure actually obtained from checked tests; 2-inch and 4-inch columns calculated, using formula $Q_1 = Q\sqrt{\frac{P_1}{P}}$ AUTHORITY—RUUD, 1904

Explosion in a Closed Vessel

Mixtures of air and Oldham coal gas

Temp. before explosion.....17° C.

Mixture		Max. Press. above atmos. in pounds per sq. in.	Temp. of explosion calculated from observed pressure	Theoretical temp. of explosion if all heat were evolved
Gas	Air			
1 vol.	14 vols.	40	806° C.	1786° C.
1 vol.	13 vols.	51.5	1033° C.	1912° C.
1 vol.	12 vols.	60	1202° C.	2058° C.
1 vol.	11 vols.	61	1220° C.	2228° C.
1 vol.	9 vols.	78	1557° C.	2670° C.
1 vol.	7 vols.	87	1733° C.	3334° C.
1 vol.	6 vols.	90	1792° C.	3808° C.
1 vol.	5 vols.	91	1812° C.	
1 vol.	4 vols.	80	1595° C.	

"Clerk, gas and oil benzine"

Table of Properties

Diameter			Thickness of metal Ins.	Circumference		Transverse Areas		
Nominal Internal Ins.	Actual Ext'rn'l Ins.	Actual Internal Ins.		Extern'l Ins.	Internal Ins.	Ext'rn'l Sq. In.	Internal Sq. In.	Metal Sq. In.
⅛	.405	.27	.068	1.272	.848	.129	.0573	.0717
¼	.54	.364	.085	1.696	1.144	.229	.1041	.1249
⅜	.675	.493	.091	2.121	1.552	.358	.1917	.1663
½	.84	.622	.109	2.639	1.957	.554	.3048	.2492
¾	1.05	.824	.113	3.299	2.589	.866	.5333	.3327
1	1.315	1.048	.134	4.131	3.292	1.358	.861	.497
1¼	1.66	1.38	.14	5.215	4.335	2.164	1.496	.668
1½	1.9	1.610	.145	5.969	5.058	2.835	2.036	.799
2	2.375	2.067	.154	7.461	6.434	4.43	3.356	1.074
2½	2.875	2.468	.204	9.032	7.753	6.492	4.780	1.712
3	3.5	3.067	.217	10.996	9.635	9.621	7.383	2.238
3½	4	3.548	.226	12.566	11.146	12.566	9.877	2.679
4	4.5	4.026	.237	14.137	12.648	15.904	12.73	3.174
4½	5	4.508	.246	15.708	14.162	19.635	15.961	3.674
5	5.563	5.045	.259	17.477	15.849	24.301	19.986	4.315
6	6.625	6.065	.28	20.813	19.054	34.472	28.890	5.582
7	7.625	7.023	.301	23.955	22.063	45.664	38.738	6.926
8	8.625	7.981	.322	27.096	25.076	58.426	50.027	8.399
9	9.625	8.937	.344	30.238	28.076	72.76	62 73	10.03
10	10.75	10.018	.366	33.772	31.476	90.763	78.823	11.940
11	11.75	11	.375	37.699	34.558	108.434	95.033	13.401
12	12.75	12	.375	40.055	37.7	127.677	113.098	14.579

of Wrought Iron Pipe

Length of pipe of square foot of External surface	Length of pipe of square foot of Internal surface	Length of pipe containing one cubic foot	Weig't per foot of length	No. of threads per in. of screw	Contents in U.S. gals. per foot of length	Weig't of water per ft. of length	Length of thread
Feet	Feet	Feet	Lbs.		Gals.	Lbs.	Ins.
9.434	14.151	2500	.241	27	.0029	.024	9/32
7.075	10.5	1383.28	.42	18	.0054	.045	3/8
5.658	7.732	754.322	.559	18	.0099	.083	7/16
4.547	6.132	473.84	.837	14	.0158	.132	1/2
3.638	4.635	270.016	1.115	14	.0277	.231	9/16
2.904	3.645	167.246	1.668	11½	.0447	.373	5/8
2.301	2.768	96.257	2.244	11½	.0777	.648	11/16
2.01	2.372	70.727	2.678	11½	.1058	.882	15/16
1.608	1.848	42 908	3.609	11½	.1743	1.453	7/8
1.329	1.548	30.337	5.739	8	.2483	2.070	1
1.091	1.245	19.504	7.536	8	.3835	3.197	1
.955	1.077	14.567	9.001	8	.5136	4.291	1 1/16
.849	.949	11.312	10.665	8	.6613	5.512	1 1/8
.764	.847	9.022	12.34	8	.829	6.910	1 1/4
.687	.757	7.205	14.502	8	1.038	8.652	1 1/4
.577	.63	4.984	18.762	8	1.500	12.503	1 3/8
.501	.543	3.717	23.271	8	2.012	16.771	1 1/2
.443	.479	2 876	28.177	8	2.599	21.664	1 5/8
.397	.427	2.29	33.701	8	3.259	27.166	1 5/8
.355	.382	1.827	40.065	8	4.095	34.134	1 3/4
.325	.347	1.515	45.02	8	4.937	41.153	1 3/4
.299	.319	1.273	48.985	8	5.875	48.972	1 7/8

Method of Determining Hardness of Water

Dissolve 13 grains of castile soap in a mixture of 500 CC. of distilled water and 500 CC. alcohol. Run into 250 CC. glass stoppered flask 58.3 CC. of clear water to be tested and add soap solution—one CC. at a time—from a burrette and shake vigorously after each addition.

When a point is reached where a persistent lather lasting five minutes is produced, note the burrette reading. The number of cubic centimeters of soap solution used minus one will be the degree of hardness of the water in terms of grains of calcium carbonate per U. S. gallon. If the degree of hardness be expressed as one grain to 70,000, then the above result multiplied by 8.3 will give the hardness.

CHEMISTS' POCKET MANUAL.

Cylindrical Vessels, Tanks and Cisterns

Diameter in Ft. and Ins., Area in Sq. Ft. and Capacity in U. S. Gals. for 1 Ft. in Depth
(1 gallon = 231 cubic inches = 1 cubic foot ÷ 7.4805 = 0.13368 cubic foot)

Diameter, ft.	Diameter, in.	Area, square feet	Gallons, 1 foot depth	Diameter, ft.	Diameter, in.	Area, square feet	Gallons, 1 foot depth	Diameter, ft.	Diameter, in.	Area, square feet	Gallons, 1 foot depth	Diameter, ft.	Diameter, in.	Area, square feet	Gallons, 1 foot depth
1	0	.785	5.87	2	7	5.241	39.21	4	2	13.635	102.00	5	9	25.97	194.25
1	1	.922	6.89	2	8	5.585	41.78	4	3	14.186	106.12	5	10	26.73	199.92
1	2	1.069	8.00	2	9	5.940	44.43	4	4	14.748	110.32	5	11	27.49	205.67
1	3	1.227	9.18	2	10	6.305	47.16	4	5	15.321	114.61	6	0	28.27	211.51
1	4	1.396	10.44	2	11	6.681	49.98	4	6	15.90	118.97	6	3	30.68	229.50
1	5	1.576	11.79	3	0	7.069	52.88	4	7	16.50	123.42	6	6	33.18	248.23
1	6	1.767	13.22	3	1	7.467	55.86	4	8	17.10	127.95	6	9	35.78	267.69
1	7	1.969	14.73	3	2	7.876	58.92	4	9	17.72	132.56	7	0	38.48	287.88
1	8	2.182	16.32	3	3	8.296	62.06	4	10	18.35	137.25	7	3	41.28	308.81
1	9	2.405	17.99	3	4	8.727	65.28	4	11	18.99	142.02	7	6	44.18	330.48
1	10	2.640	19.75	3	5	9.168	68.58	5	0	19.63	146.88	7	9	47.17	352.88
1	11	2.885	21.58	3	6	9.621	71.97	5	1	20.29	151.82	8	0	50.27	376.01
2	0	3.142	23.50	3	7	10.085	75.44	5	2	20.97	156.83	8	3	53.46	399.88
2	1	2.409	25.50	3	8	10.559	78.99	5	3	21.65	161.93	8	6	56.75	424.48
2	2	3.687	27.58	3	9	11.045	82.62	5	4	22.34	167.12	8	9	60.13	449.82
2	3	3.976	29.74	3	10	11.541	86.33	5	5	23.04	172.38	9	0	63.62	475.89
2	4	4.276	31.99	3	11	12.048	90.13	5	6	23.76	177.72	9	3	67.20	502.70
2	5	4.587	34.31	4	0	12.566	94.00	5	7	24.48	183.15	9	6	70.88	530.24
2	6	4.909	36.72	4	1	13.095	97.96	5	8	25.22	188.66	9	9	74.66	558.51

Capacity of Dry Gas Meters in Cu. Ft. per Hour

Meter Manufacturer	Loss in inches of Water	Size Meter											
		3-Lt	5-Lt	10-Lt	20-Lt	30-Lt	45-Lt	60-Lt	3-Lt B	5-Lt B	10-Lt B	30-Lt B	60-Lt B
Keystone Meter Co.	½"	105	136	210	300	375	700	800	....	150	275	....	....
Maryland Meter Co.	½"	....	....	....	270	....	480	....	114	158	275	660	1350
D. McDonald & Co.	½"	90	....	....	225	310	450	550	....	150	250	550	1200
American Meter Co.	½"	60	99	131	234	294	423	480	....	121	211	586	1120
New York Imp. Mt. Co.	½"	....	146	245	254	453	453	750	....	....	....	....	....
Cleveland Gas Meter Co.	Not given	75	156	275	450	650	....	....	....	....	....	....	....
John J. Griffin Co.	Not given	90	140	250	....	....	....	....	....	....	....	....	....
Standard Meter Co.	Not given	198	234	324	492	642	804	1104	....	....	....	....	....

		Size Meter											
		No. 1	No. 1-A	No. 2	No. 3	No. 4	No. 5	No. 3-A	No. 5-A	No. 10-A	No. 20-A	No. 30-A	No. 60-A
Equitable Meter Co.	Not given	300	....	400	500	600	100	....	....	....	....	....	....
Sprague Meter Co.	½"	....	165	300	345	....	750	....	....	....	....	....	....
Hehne & McIlhaney.	½"	....	....	....	....	....	....	....	175	357	....	875	1500
John J. Griffin Co.	Not given	....	....	....	....	....	....	....	175	375	....	875	1800
Cleveland Gas Meter Co.	Not given	....	....	....	....	....	....	100	200	375	575	875	1800
Keystone Meter Co.	½"	....	....	....	....	....	....	....	175	375	875	....	1800
Cleveland Gas Meter Co.	Not given	....	....	....	....	....	....	100	200	375	575	875	1800
Keystone Meter Co.	½"	....	....	....	....	....	....	....	175	375	875	....	1800
Pittsburgh Meter Co.	Not given	165	....	500	365	600	....	....	....	....	....	....	....

Connections usually are—

For 3-light meters ¾" pipe
For 5-light meters ½" pipe
For 10-light meters ¾" pipe
For 20-light meters 1" pipe
For 30-light meters 1¼" pipe
For 45-light meters 1½" pipe
For 60-light meters 1½" pipe

Heating Water by Steam Coils. Latent heat of steam, 966 B. T. U.

Mean Temp. Diff.	Lbs. Steam Condensed per hour Per Sq. Ft. of Pipe			Lbs. Steam Condensed per hour per Sq. Ft. per Degree difference			B. T. U. per Sq. Ft. per hour per Degree difference		
	Iron	Brass	Copper	Iron	Brass	Copper	Iron	Brass	Copper
50	7.5	12.5	14.5	0.150	0.250	0.290	101	198	280
100	18.5	38.0	43.5	0.185	0.380	0.435	179	367	415
150	32.2	76.5	87.8	0.215	0.510	0.585	208	493	565
200	48.0	128.0	144.0	0.240	0.640	0.720	232	618	696

Tests of Commercial Pipe Coverings

Kind of Covering	Thickness of covering, inches	Lbs. Steam condensed per sq. ft. per hour	B. T. U. per sq. ft. per minute	B. T. U. per sq.ft. per hr. per deg. av. difference of temp.	Saving due to covering, lbs. steam per hour per sq. ft.	Ratio of Heat lost, Bare to Covered Pipe, %	H. P. lost per 100 sq. ft. of Pipe (30 lbs. per hr = 1 Hp.)
Bare pipe	....	0.846	12.27	2.706	....	100.0	2.819
Magnesia	1.25	0.120	1.74	0.384	0.726	14.2	0.400
Rock wool	1.60	0.080	1.16	0.256	0.766	9.5	0.267
Mineral wool	1.30	0.089	1.29	0.285	0.757	10.5	0.297
Fire-felt	1.30	0.157	2.28	0.502	0.689	18.6	0.523
Manville sectional	1.70	0.109	1.59	0.350	0.737	12.9	0.564
Manv. sect. and hair-felt	2.40	0.066	0.96	0.212	0.780	7.8	0.221
Manville wool cement	2.20	0.108	1.56	0.345	0.738	12.7	0.359
Champion mineral wool	1.44	0.099	1.44	0.317	0.747	11.7	0.330
Hair-felt	0.82	0.132	1.91	0.422	0.714	15.6	0.439
Riley cement	0.75	0.298	4.32	0.953	0.548	35.2	0.993
Fossil-meal	0.75	0.275	3.99	0.879	0.571	32.5	0.919

Model Specification for Architects

Ruud Instantaneous Automatic Water Heaters

Ruud Cottage Water Heaters

Install where indicated on plans, one No. ..... Ruud Instantaneous Automatic Water Heater. Take cold water connection off main at convenient point, run to heater, using full size pipe as indicated in directions. Connect hot water from heater to hot lines, using pipe not smaller than size indicated in directions.

Connect gas line to heater, run line direct from meter to heater, not smaller than indicated in directions.

Connect vent from heater to independent chimney, if available, of size not smaller than indicated in directions. Install Ruud Draft Hood in vertical position.

Model Specification for Architects

Ruud No. 30 and 50 Class Storage

Install where indicated on plans, one No. .....Ruud Automatic Storage System. Take cold water connection off main at convenient point, run to boiler, using full size pipe, as indicated in directions. Connect hot water from boiler to hot lines, using pipe not smaller than size indicated in directions.

Connect gas line, not smaller than indicated on directions, to the inlet opening on Moment Valve.

Connect vent from heater to chimney, of size not smaller than indicated on directions. Install Ruud Draft Hood in vertical position.

Model Specification for Architects

Ruud Multi-Coil Storage Systems

One.....Gallon (Black Iron, Galvanized Iron, or Copper) Tank, as supplied by Ruud Manufacturing Company, to be supported in horizontal position on Ruud Tank Supports, and fitted in automatic connection with one No..... Ruud Multi-Coil Storage Heater, using .....inch brass pipe as circulators between heater and boiler, with ..... inch Gate Valves and Elbows; system to be fitted in exact accordance with Ruud Manufacturing Company's printed directions, running direct .....inch gas line direct from meter to heater, with .....inch gas cock in same.

A .....inch independent flue pipe to be run from heater to chimney having good draft, inserting draft hood in vent line in a vertical position.

Cover tank with a 2-inch wall of 85% Ruud Magnesia Insulation, canvassed.

PITTSBURGH TESTING LABORATORY,

INSPECTING AND METALLURGICAL ENGINEERS
AND CHEMISTS.
PITTSBURGH, PA.

12th May 190[illegible]

Report of Tests of Instantaneous Automatic Water Heaters.
Made for Ruud Manufacturing Company, Pittsburg, Pa.

Ruud Instantaneous Automatic Water Heater, Size 4, Type F, Serial 17053

Temperature of Feed Water Degrees F.	Heat of Feed Water B. T. U.	Temperature of Discharge Water Degrees F.	Heat of Discharge Water B. T. U.	Temperature Rise of Water Degrees F	Heat Rise of Heated Water B. T. U.	Temperature of Flue Gases Degrees F	Amount of Water Heated Pounds	Total Heat Given to Water B. T. U.	Amount of Gas Used Cubic Feet	Heat Value of Gas Used B. T. U.	Efficiency of Heater Per Cent.
54	22.11	139.5	107.7	85.5	84.59	324	312	26392.08	31.95	31950	82.60
54	22.11	144	112.2	90	90.09		283	25495.47	31.40	31400	81.19
54	22.11	151	119.3	97	97.19	321	262.5	25512.38	30.80	30800	82.83
54	22.11	180	148.5	126	126.39	336	203	25657.17	32.25	32250	79.55

AVERAGE EFFICIENCY 81.54

Efficiency Tests

Ruud Instantaneous Automatic Water Heater, Thermal Valve Type F Model

Highest Awards from various Expositions and Societies, expressing the Mechanical Superiority and Commercial Achievements of the Ruud.

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